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# ROENTGENOLOGY OF THE COLON

## ITS VALUE IN CLINICAL MEDICINE*

BY J. W. LARIMORE, M.D.

SAINT LOUIS, MISSOURI

THE roentgenological observation of the alimentary tract has until recently been chiefly activated by the surgical viewpoint. The effort has been to determine or eliminate pathological anatomical changes. It is becoming more and more evident that roentgenoscopic and roentgenographic observation of the alimentary canal reveals a great deal of functional disturbance or of pathological physiology which has important clinical uses. It would appear that this recent emphasis upon the interpretation of function by the roentgen ray has come about because the roentgenological observation of the alimentary canal has been increasingly taken up by the clinical gastroenterologist. In consequence, the clinical, functional and pathological status has been more and more correlated with the findings. The physiological changes associated with many functional affections and the occurrence of many individual developmental variations are receiving closer scrutiny and are necessitating a more extended routine of examination.

The interpretation of the roentgenology as regards function depends almost completely upon precedents established by correlation of the history and the other clinical and laboratory findings. This process is a more intangible one than is the interpretation of the findings in organic disease. These are finally elucidated by the definite surgical or autopsy confirmations.

This paper will restrict itself to the colon and will omit consideration of the organic or surgical diseases. The anatomical variations of the colon within the realm of the normal are numerous and varied. These anatomical variations are, however, fundamentally important in the pathological physiology of the bowel. The essential anatomical structures of the bowel and their function must form the basis of interpretation. The total function of the colon depends upon its being a muscular tube, lined by glandular epithelium, being well supplied with vascular structures facilitating absorption, and having an intrinsic nerve plexus subject to extrinsic nerve control. Its normal function depends upon the integrity of these elements, and failure of such integrity will produce abnormal function of varying type and degree. The total length of the colon (excluding the rectum) varies enormously from a minimum of 1 meter to a maximum of 3.25 meters.[1] This length must be partially determining as to the total time of the stool movement. The rate of progress

* From the Department of Internal Medicine and the Department of Radiology, Washington University Medical School. Read before the Section on Radiology, Southern Medical Association, November 19, 1927.

Fig. 1. Barium enema of an "average" colon with medium length and orthotonic haustrations.

Fig. 2. Barium enema in a hypersthenic man, showing a relative hypertonicity in all segments and also in the small intestine. This hypertonus is characteristic of the habitus rather than an abnormal increase.

Fig. 3. Barium enema illustrating the long right cecocolon occurring by hyperrotation and by exaggerated descent of the cecum. And in this case there is a pathological physiological status in the moderate dilatation and loss of tonus of the cecum, which causes a marked cecal stasis and colonic motor delay.

Fig. 4. The twenty-four hour observation of the barium meal in the same case as Figure 3 demonstrating the marked cecal stasis.

Fig. 5. Barium enema showing cecal dilatation and hypotonicity of the ascending colon associated with an extreme hyperrotation and descent of the cecum. There was a relative exaggerated length of the entire colon with redundancy and hypotonicity of the distal segments. Constipation was constant in varying degree. This patient has attacks of pain and vomiting and subjective disturbances associated with periods of increased constipation. Appendectomy and cholecystectomy did not give relief.

Fig. 6. The twenty-four hour observation of the barium meal demonstrating the cecal stasis in a sthenic adolescent girl. The barium enema demonstrated a marked hyperrotation of the colon with a moderate associated distal redundancy and a general loss of tone and moderate cecal dilatation. Right lower abdominal discomfort accompanied an obstinate constipation. Careful observance of all hygienic measures are necessary to maintain functional adequacy in this combination of anatomical attributes.

determines the amount of absorption or degree of inspissation. The segmental distribution site in the colon of the variations in length has fundamental importance. The relation of the colon to its mesentery has not, in the author's experience, often had clinical significance. The cecum mobile, sigmoid mobile, and V-transverse colon may rarely be mechanically displaced as in volvulus but they are otherwise non-determining as to function. The increased and often very great length of the right colon increases the absorption from that segment. The redundancies, which occur chiefly distally, increase and accentuate the inspissation of the stool. Total and segmental motor adequacy may be maintained so long as the neuro-muscular mechanism is normal. Serious results occur with functional or anatomical damage to that mechanism. Decompensation of the tonus of the bowel musculature is the most frequent physiological change. Exaggeration of tonus occurs relatively seldom. Tonus of plain muscle is defined as its resistance to extension,[2] and this conception is of the muscle fiber and not of the neuro-muscular mechanism. The smooth muscle fiber possesses intrinsic tonus and tends always to a shortened "posture" which, as will be mentioned below, gives an inherent tendency to the correction of abnormal states. The muscle aggregate, however, may show its loss of tonus by the sliding of muscle cells from one another and the consequent thinning of their layer thickness,

The tonus of the colonic musculature is revealed in the roentgenogram by the width or diameter of the colon and chiefly by the contour and number of the haustrations (Fig. 1). The hypotonic bowel will show haustrations which obviously take their form from apposition to each other and to the contiguous or surrounding abdominal organs; they are few in number and are absent in the atonic bowel (Fig.

Fig. 7. Barium enema showing an enormous dilatation of the cecum (megacecum), but without stasis. The total colonic motility is adequate. In comparison with lesser degrees of dilatation it would seem that cecal absorption is impaired, allowing for a persistent fluidity which permits the more prompt washing out of its content. Plication of this cecum on the occasion of laparotomy for removal of a uterine fibroid tumor gave no subsequent change in its roentgen form or size.

Fig. 8. Barium enema in a young woman of low mentality, demonstrating extreme general redundancy and loss of tonus. This was initiated and permitted by persisting bad hygiene. The capacity of this colon is much over twice that of the usual length and the redundant bowel in the proximal segments are poorly visualized because of the crowding into them of residual unbariumized colonic content.

19). These contrast with the orthotonic (Figs. 1 and 2) and spastic haustrations of the colon (Fig. 12) which clearly express in their contour a determining tension of the muscle; their number is greater. The influence of bodily habitus upon tonus of the bowel must be considered in evaluating the departures from normal (Fig. 2). Normal tonus is directly proportional to the character of bodily habitus. Heightened tonus must be distinguished from neuro-muscular irritability (Fig. 14) which is manifested by irregularity of haustrations varying in degree from asymmetry to a serration of the border, which may be thought of as fibrillation of the muscle. These various changes may arise from extrinsic stimulation of the controlling autonomic nerves, irritation or atrophy of the intrinsic nerve plexus, irritation of the muscle directly or from exhaustion of the muscle.

Most frequent among the clinical impairments and alterations of function of the colon are those resulting in altered motilities—diarrhea and constipation. Many combinations of the several usual variations of anatomy and physiology may be shown by the roentgenological pictures. Constipation has classically been divided into the two groups of spastic and atonic. The spastic group has usually been stated to be the more frequent. Roentgenological observation has changed this conception in clearly demonstrating that "atonic" constipation due to diminished muscle function is by far the more frequent (Fig. 25). Pain association probably accounts for the earlier clinical classification; however, it is now known that pain accompanies the hypotonic redundant colon (Fig. 19). The segmental site of the delayed motility or constipation is determined by the distribution of this determining hypotonicity. Accordingly, constipation may be a totally impaired colonic motility, a right colonic or a cecocolic impairment, a distally impaired motility, or a rectal residual delay.

In an analysis of 562 colons as observed by barium meal and by barium enema, the author[3] has shown an incidence of hyperrotation or exaggerated length of the right

FIG. 9. Barium enema showing combined hyperrotation and general redundancy, but more accentuated distally in the sigmoid. There is a general hypotonicity with marked motor impairment and clinical constipation. Pituitrin has aided in improving the function.

FIG. 10. The six hour observation in the same case as Figure 9, showing the influence of colonic condition on the motilities of the higher alimentary tract with a functional gastric motor insufficiency and small intestinal "recoil" as evidenced by the gas-filled forms of the ileum.

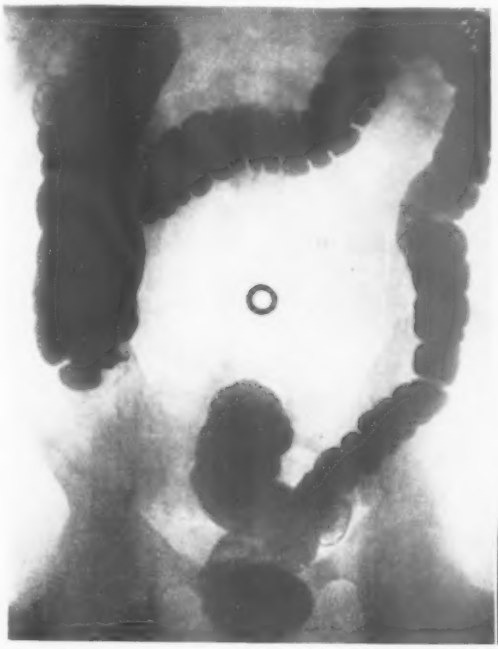

FIG. 11. Barium enema in a sthenic man suffering with idiopathic epilepsy who had become a habitual user of cathartics through his morbid association of colonic function with the attacks. The normal status of posture and tonus in this colon indicates a functional adequacy if allowed by hygienic care and opportunity.

FIG. 12. Barium enema in a case of true spastic constipation showing the extreme hypertonus (spasticity) of the distal colonic segments. This case was very intolerant to laxatives. Restoration of normal function was accompanied by return of orthotonus shown roentgenographically.

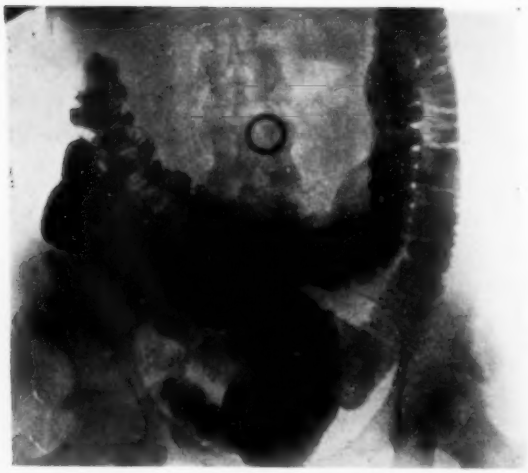

Fig. 13. Barium enema in a case of hyperthyroidism showing diarrhea. The basal metabolic rate was plus 131.4 per cent. This diarrhea was proportional to and subsided with control of the thyrotoxicosis. The generally narrowed, tubular contour of the colon indicates an increased posture of muscle tonus and the many symmetrical contractions show a heightened tonus of the nerve plexus.

cecal stasis is frequently associated with this variation, and increases in degree with the progressive decompensation (loss of tone) of the muscle. Pain may accompany this stasis and the appendix is often removed. Kantor[4] has noted the high incidence of vomiting, constipation, headache, and of appendectomy to the low cecum. The association of this type of colon with right colonic stasis to migraine has been striking in my experience. Recurrent (cyclic) vomiting in children is frequently associated, and pain attacks may occur in the female, presumably from pressure upon the pelvic organs. Collateral effects of cecal dilatation are theoretical. The inspissation of the content which is obvious and conclusive in the lesser degrees of dilatation and of stasis seems to disappear in the more pronounced dilatations (Fig. -), and from this it is presumed that the absorbing faculty of the segment is lost and that the persist-

Fig. 14. Barium enema in a case of chronic diarrhea of five years' standing, uncontrolled by all medication and showing complete compensation by the use of a diet of vitamine-rich food which had always previously been entirely neglected by the patient, and prescribed in treatment.

Fig. 15. Barium enema in the same case as Figure 14, demonstrating very marked prompt improvement of colonic attributes with a return to normal function. The marked irritability is replaced by more normal haustrations. The clinical improvement is permanent during two years.

cecocolic segment with pelvic position of the cecum in 13.2 per cent of individuals (Figs. 3 to 6). A right colonic motor delay or

ing fluidity of the content permits it to be washed into the more distal normal segments. This local adynamic motility

FIG. 16. Barium enema in the case of a mild, variable and recurrent diarrhea. The atypical contours showing asymmetry, irritability and stiffness have been found characteristic of diarrhea associated with a one-sided diet lacking vitamine content. Such a diet was clinically determined in this case and correction of diet relieved all symptoms.

FIG. 17. Barium enema in the same case as Figure 16 showing a definitely improved status of the bowel with haustrations approaching the normal, symmetrical type.

FIG. 18. Barium enema in a case of extreme inanition and with moderate pellagrous skin changes showing relaxed tubular contour with atypical haustrations, a definite abnormal state which appears prior to the onset of diarrhea.

FIG. 19. Barium enema demonstrating the end-results in a case of chronic ulcerative colitis following an ileostomy. The narrowing and shortening of the lumen demonstrates the progressive and extreme muscle contracture which supervenes in chronic diarrheal conditions. This is allowed by the isolation of the muscle resulting from degeneration of the intrinsic nerve plexuses.

becomes adequate and the failure of absorption relieves from the possible influence of autointoxication. In the author's series,[3] redundancy of the sigmoid segment (Figs. 8 and 9) occurred in 18 per cent and was of greater incidence in the sthenic type of bodily habitus. This redundancy is accompanied by a high incidence of motor impairment. The incidence is directly proportional to the length of the redundancy and to the degree of the loss of neuro-muscular tonus. White[5] finds, in the order of their frequency, constipation, gas with abdominal distress, pain in the abdomen, vomiting and diarrhea, and an intermittent tumor as the symptoms accompanying this condition. He finds the diagnosis to depend upon the roentgenological findings and believes the condition to be a definite entity.

Impaired colonic motility rising from loss of tone in all segments may and may not be of serious prognosis, depending upon the origin of the loss of tone. Undue extension of the musculature in any one or all segments is the most common cause and results chiefly from bad hygiene and neglect. This may have only established an inadequate posture of the muscle, and a restoration of a functional posture may be readily obtained by removing the factors of bowel distention and hence of muscle extension.

The intrinsic tonus of the muscle will cause recovery by its shortening to a more adequate tonus. This character of smooth muscle is most spectacularly illustrated in the clinical response of the acutely dilated stomach to lavage and emptying. The restoration and maintenance of orthotonus of the bowel necessitates a soft colonic content which will yield to muscle contraction. If distention of the bowel has been of long duration and marked degree, the muscle will become exhausted, attenuated, and more or less permanently damaged, and therapy by hygienic protection must persist for a very prolonged period to allow its possible repair.

Many times in the presence of a clinical (claimed) constipation the roentgenological picture will show a surprising normalcy of the colon in its length, topography and tonus (Fig. 11). Because of this normalcy of its attributes, the indicated treatment is for the colon to be relieved of the influence of habitual laxatives to which the morbid attention of its owner has subjected it. It can, and will, then return to adequate normal function.

Hypertonicity of the colonic musculature results in prompt or overprompt motilities. Not until the hypertonicity becomes very greatly exaggerated will there result an impairment (delay) of colonic motility—spastic constipation (Fig. 12). When this hypertonicity is of such degree as to be the determining factor in delayed motilities, intolerance to the use of laxatives will be associated. They will increase the spasticity and pain, and accentuate the constipation. This intolerance is a diagnostic sign of the condition.

While it may be stated that hypertonus of the colon is usually associated with diarrhea or at least with prompt or overprompt colonic function, as is well illustrated by the diarrhea accompanying hyperthyroidism (Fig. 13), it does not follow that all diarrheas are dependent upon colonic hypertonus and hyperperistalsis. As will be mentioned later, certain types of diarrhea are entirely adynamic and result from the overflow of the colon and depend upon a washing-out process.

The colonic structures are highly labile to general and local nutritional conditions. The effects of partial inanition have been recognized by pathologists for a long time. The effect of restricted unbalanced diet is manifest in the colon and is shown by its roentgenological picture. Lack of vitamines leads to definite changes and altered function, which in the earlier phases is readily repaired by correction of diet. These colonic changes may initiate a vicious circle in general avitaminosis. They impair absorption. They permit the penetration of bacteria both pathogenic and saprophytic and are hence determining in infections of the bowel and also allow more remote bacterial influences. This avitaminosis varies widely in degree. All structures, muscle, nerve, and glands, fail in their nutritional integrity. The early irritability is manifested through progressive stages from increased mucus production to irritation hyperperistalsis (Figs. 14 to 18) and diarrhea. The late degenerative changes

Fig. 20. Barium enema in a case of urgent diarrhea in the late course of pulmonary and alimentary tuberculosis. The colonic changes are secondary and superimposed upon the initial colon involvement of the bowel. The infrahepatic position of the appendix resulting from the inverted position of the cecum is of incidental interest.

Fig. 21. Barium enema in a case of chronic adynamic diarrhea. The general syndrome suggested sprue without demonstration of the monilia. There was an achlorhydria gastrica. Full clinical compensation was secured by the administration of adequate hydrochloric acid.

show a friability of the mucous membrane, atrophy of the intrinsic nerve mechanism, the invasion of bacteria, and contractural changes in the isolated (from nerve) muscle fibers (Fig. 19). Persistence of diarrhea resulting from or associated with an avitaminosis initiates a vicious circle of progressive damage to the structures. This is a determining factor in chronic ulcerative colitis.[6] This is an end-result of the diarrhea initiated by secondary ulcerative tuberculosis of the cecocolon.

There occurs a type of extreme colonic dilatation usually associated with an adynamic diarrhea, which should not be confused with true megacolon. The roentgenological picture is one of a markedly distended, hypotonic, ahaustral and lengthened bowel, filling the abdomen and showing an extremely increased enema capacity. This condition has been found in cases of sprue, in the pernicious type of anemia, and with idiopathic achlorhydria (Figs. 21 to 24). Improvement of the bowel status has accompanied clinical improvement of the associated disease. The diarrheal nature of colonic emptying has appeared as chiefly

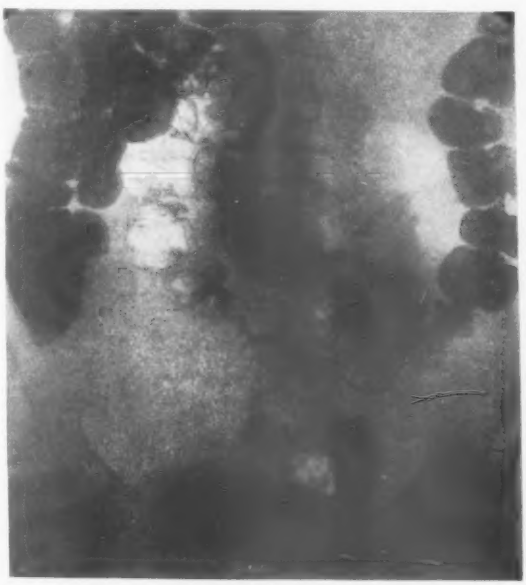

Fig. 22. The twenty-four hour observation in same case as Figure 21 demonstrating a type of total colonic motility, which is chiefly adynamic due to a washing-out process resulting from the combined factors of increased upper alimentary secretion and of impaired absorption, especially distally.

the results of a washing out and replacement process rather than the effect of

Fig. 23. Barium enema after eight weeks of treatment in the same case as Figures 21 and 22, demonstrating a return of normal colonic attributes with marked increase in tone. Function at this period had become clinically normal. Similar cases have shown no effect from sine wave electrical treatment.

Fig. 24. Barium enema in a case of sprue showing the extreme hypotonicity and relaxed dilatation of the entire colon. The diarrhea in this case was of the adynamic type.

Fig. 25. Barium enema of colon showing marked general hypotonicity with redundancy and increase in length associated with extreme clinical constipation. The right-sided position of the sigmoid is casual and without significance.

Fig. 26. Barium enema in the same case as Figure 25 and after one week of daily treatment by sine wave electricity, demonstrating the markedly improved tone with lessened diameter, tonic haustrations and diminished length. The enema capacity was greatly reduced from that of the original examination. There was immediately only a moderate improvement of function. Subsequent improvement was progressive. Posture may be restored before adequate recovery of muscle strength.

Fig. 27. Barium enema in the case of advanced ileocecal tuberculosis showing the intolerance (nonfilling) of the cecum and the atypical contours of the proximal transverse colon which are due to associated secondary colitis and not to direct involvement by tuberculosis. Distal hypotonicity suggests a distal colonic impaired motility (atonic constipation).

Fig. 28. Barium enema in acute ulcerative colitis rapidly terminal and subsequently determined to be of amebic origin. The colonic changes are secondary and superimposed upon the primary amebic pathology.

muscular effort. No effect of sine wave electricity has been secured in this type of condition (Figs. 25 and 26).

Inflammatory diseases of the colon are often so acute that roentgenological observations cannot be obtained. Some of the more chronic and indolent infections and infestations have more or less diagnostic pictures and their study has aided in understanding the damage to the different anatomical structures, and has developed diagnostic precedents of interpretation. Tuberculosis has a predilection for the ileocecal intestinal segment (Fig. 27), and when this segment is involved in the presence of pulmonary tuberculosis the diagnosis has a large presumptive probability. Without this combination the etiological diagnosis is indeterminate by the roentgenological findings, and tuberculoma, retrocecal appendix, appendix abscesses, mesenteric adenitis, carcinoma and idiopathic infection are with difficulty and only with clinical help differentiated. Irritability of the cecum to palpation which may be roentgenoscopically demonstrated, is the earliest roentgenological sign, and appears prior to the roentgenological and clinical increase of colonic motilities.[7] It may be demonstrated prior to involvement of the serosa. Appendectomy alone may in these cases lead to the disaster of a subsequent sinus or fistula. Irritability of the cecum discovered in course of the roentgenological attention to the appendix must suggest a tuberculous etiology.

Amebiasis, when affecting the entire colon, gives a characteristic picture. The mucous membrane and submucosa alone are damaged and the luminal contours are made "feathery" by the discharges from and on the mucosa, and are serrated by the irritable muscle action. A secondary acute colitis superimposed upon any amebic infestation (Fig. 28) can give the appearance of acute idiopathic ulcerative colitis and show a fulminating clinical course. The intractable recurrent cases of amebiasis suggest a localized chronic organic lesion in which the amebae are sequestered from the therapeutic agents. A callous ulcer of the hepatic flexure simulating roentgenoscopically carcinoma has been seen to do this.[8] Syphilis of the colon more often involves the rectum and is a frequent

Fig. 29. Barium enema in a case of acute lichen planus demonstrating the influence of this disease upon the alimentary mucous membrane. The picture is similar to colitis and shows the narrowing and stiffening of the atypical haustra.

Fig. 30. Barium enema demonstrating a megacolon of the acquired type. The general dilatation of the bowel with hypertrophy of its musculature is evident by the general and haustral contours. This case is an adult having, residual from infancy, a paralysis of the legs and pelvis necessitating the use of crutches. The association of this lower spinal cord disease to these colonic changes is hypothetical and problematic, and offers several theoretical and conflicting explanations. Colonic function was only periodically impaired and was then accompanied by abdominal pain and vomiting.

cause of stricture of the rectum. The roentgenological picture is characteristic in showing an extreme contraction of the rectum. Some dermatological diseases affect the mucous membranes. An observation in an acute case of lichen planus illustrates this (Fig. 29).

The empirical association of chronic non-infectious arthritis, especially of the spine, with abnormal colonic function is constantly recurring and securing attention. The factor of colonic stasis is emphasized in renal pelvic infections. The suggestion of a cause and effect relationship is unavoidable. The cecal stasis of the hyperrotated colon is often present, but the relationship awaits full elucidation. Arthritis is a frequent complication of chronic ulcerative colitis and of colonic diverticulosis. Changes in the wall of the bowel must occur to allow this permeability to the bacteria or to their toxins, or to other toxic agents. Roentgenology cannot show such changes, but may reveal the associated characteristic gross alterations of contour, topography, tonus, and irritability.

The occurrence of megacolon (Fig. 30), both the acquired and congenital types, is conclusively determined in fact and in extent only by roentgen examination. The full differentiation of the neurogenic from the other types can be made only from the other clinical findings. Some suggestive differences are observed in the film, but without larger experience these are only suggestive. The coordination of the voluntary abdominal muscles to the peristaltic action of the distal bowel evidences the central control as does also the normal gastrocolic reflex and its diarrheal exaggeration which is controlled by atropine. The results of central cord lesions and the influence of operative removal of the nerve connections await more observation than has been secured.

## SUMMARY

The author has attempted to illustrate in these demonstrations which have been

limited to those of purely medical import, first, that roentgenology reveals many alterations of colonic physiology, and second, that the understanding of these depends upon and is in proportion to their correlation with general clinical findings. This field of observation is as yet relatively untouched and will prove fertile with the help of correlated clinical observations.


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# IMPORTANCE OF EARLY DIAGNOSIS OF CANCER OF THE COLON

## CASE REPORT


BY GEORGE GOLDMAN, M.D.

NEW HAVEN, CONNECTICUT


THE importance of early diagnosis of cancer of the colon cannot be over emphasized, inasmuch as delayed metastasis, which is usual in these cases, makes early diagnosis, especially by means of the roentgen ray, quite essential. Early surgical intervention very often changes the prognosis of the case.

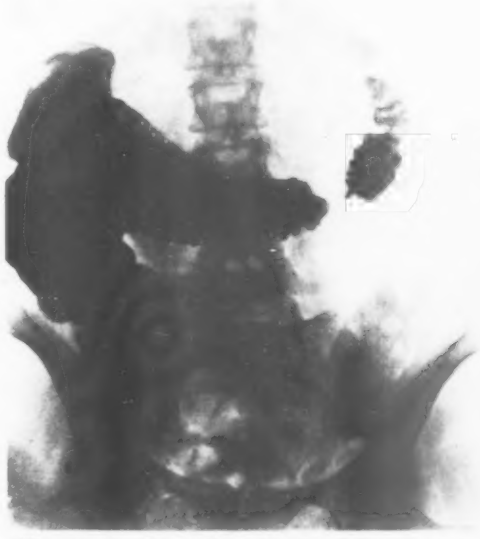

Fig. 1. Twenty-four hour plate showing defect at transverse colon.

Fig. 2. Forty-eight hour plate showing defect, with picture of increased obstruction.

It is with this object in view, that I report the following case.

CASE REPORT

The patient, Mrs. M. B., aged fifty, referred for roentgen examination, complained of having had several attacks of abdominal pains and vomiting in the past three or four weeks, each attack lasting several days. These attacks

Fig. 3. Sixty hour plate showing same defect, with distal colon filled following barium enema.

were accompanied by constipation, and were relieved by laxatives. The pains were not very severe but the vomiting was becoming a daily occurrence. She also complained of anorexia, loss of weight, and general weakness.

Her past history and family history were essentially negative.

Palpation of abdomen was negative, except for tenderness on pressure of the upper abdomen, especially of the upper left quadrant.

*Roentgen-ray Report.* Figure 1 (twenty-four hour plate) shows a marked dilatation of the proximal colon, with a filling defect just to the left of the middle of the transverse colon, and some of the meal trickling through beyond the defect.

Figure 2 (forty-eight hour) shows increased dilatation of the colon proximal to the defect, with incompetency of the ileocecal valve due to the back pressure. The caliber of the transverse colon distal to the defect is small, and shows only a small amount of the meal.

Figure 3 (sixty hours, following a barium enema) shows the distal colon filled up to the defect. The proximal colon is still markedly dilated with the barium.

*Roentgen Diagnosis.* Annular carcinoma of the transverse colon.

The patient was operated on by Dr. Maxwell Lear of the Grace Hospital staff.

The operation which was done in two stages, consisted of a cecostomy to drain the proximal colon, followed in three weeks by a resection and end-to-end anastomosis.

Pathological report by Dr. C. J. Bartlett. Microscopic examination of section shows an adenocarcinoma of the colon, extending through the muscle coats.

The patient has completely recovered, and is now, one year after operation, having normal evacuation at regular intervals, has gained in weight, and her general condition is excellent.

*Summary.* This case is reported in order to point out the value of early diagnosis in carcinoma of the colon, and the important part played by the barium meal.

Vol. XX, No. 2

# POLYPOSIS OF THE LARGE INTESTINE

## CASE REPORT

BY JOHN F. CHAPMAN, M.D.

PASADENA, CALIFORNIA

THE following interesting case was admitted to the Pasadena Hospital in February, 192-, as a patient of Dr. Frederick A. Speik, to whom I am indebted for permission to report it, and it is his clinical record which will be summarized.

The patient, Mrs. D., was forty-nine years of age. Her present illness she thinks began with an attack of indigestion in September, 1926, when she vomited old food. There was but little nausea, and but little pain, and since then she has had no real pain, but she has had gnawing, burning, and hunger sensations in the upper abdomen, and visible distention of the abdomen with gas, which she has seen moving across the abdomen. It is accompanied with considerable gurgling. She feels better when there is food in her stomach, for it seems to cause the gas to move on. Soda bicarbonate gives some relief, but not complete. She has been constipated, and her bowels do not move without stimulation, but no unusual amount of cathartic has been necessary.

*Past History*. No significant diseases, no operations, never jaundiced. Menstruation regular until 1926, none since, and no pelvic symptoms. Four years ago she weighed 136 lbs., two years ago 118 lbs., and she now weighs 86 lbs.

*Family History*. No record of cancer in parents, brothers or sisters. Husband living and well, and two children living and well.

*Physical Examination*. Very poorly nourished, no great pallor, and moderate weakness. Head, neck, and thorax essentially negative. Abdomen, liver edge palpable under the right costal margin. There is a palpable mass in the epigastrium, which is tender. The transverse colon is palpable, tender, and peristalsis can be seen moving across the upper abdomen from right to left. No other significant findings.

*Roentgen Examination*. A gastrointestinal roentgen-ray study was made. Under the roentgenoscope the stomach was seen to be freely movable, and to possess a fair amount of flexibility. About the middle of the greater curvature a small outpocketing or niche was observed, and it appeared on nearly all of the films. Just below this, toward the pylorus, there was a large filling defect, through which no peristaltic waves passed, and which could not be filled by palpation. This showed on most of the films, and involved the greater curvature predominantly, but some of the films showed that it extended around the stomach to involve the lesser curvature to a slight degree. Just below this the stomach filled out; the pyloric zone, and a much-dilated duodenal bulb could be plainly seen. The niche and filling defect can be seen in Figure 1.

Six hours later the stomach had completely emptied; considerable barium remained in the small bowel, and the cecum and ascending colon were well filled. In Figure 2 the barium distribution is seen after the six-hour interval. Slightly below the hepatic flexure, the lumen of the bowel suddenly narrows, and only a streak is seen running through the transverse colon to a point just to the left of the midline, where, in a short segment there is much less constriction. From this point up to the splenic flexure no barium appears, but it appears scattered in large irregular masses down the descending colon, and a little appears well down in the sigmoid, demonstrating that although there is a marked constriction of a long segment of the transverse colon, still the barium mixture passed through it readily.

A film taken after an interval of twenty hours (Fig. 3) showed the extent of the defect better than any of the others. Most of the meal had passed the defect, and appeared on the left side of the colon.

A barium enema was given, and the resulting film is shown in Figure 4. It will be noted that the opaque material has well filled and dilated the rectum, sigmoid, and descending colon. The barium has made the turn at the splenic flexure, and passed a short distance into the transverse colon. Here it came to a sudden stop, and only a small amount streaked through the transverse colon to near its midpoint, where a short segment showed a somewhat wider lumen, corresponding to the finding of the six-hour examination.

A second barium meal corroborated the findings of the first, and a second enema duplicated the findings of the first enema. This left us with a most amazing group of findings, namely, a niche on the greater curvature of the stomach which certainly looked like an ulcer in an atypical position, a filling defect just

beyond it on the greater curvature which had the appearance of malignancy, and a well-proved and extensive filling defect in the

Fig. 1. Stomach, showing constantly appearing niche on greater curvature, and large constantly appearing filling defect in the greater curvature just below it.

colon. A tentative diagnosis of carcinoma of the transverse colon was made. However, it was pointed out by Dr. C. H. Parker that the extensiveness of the defect in the transverse colon was in itself rather strong evidence against a diagnosis of carcinoma, and that if it were carcinoma it would be found at operation that the actual defect would probably not correspond very closely to the defects shown roentgenographically.

A laparotomy was done, and an extensive area of induration was found in the midportion of the greater curvature of the stomach. Nothing to correspond with the niche seen in the roentgenograms was found, but Dr. McGee, the surgeon, considered the indurated area to be due to ulcer. The stomach was not opened. The colon was found to be much narrowed, and thickened from a point about 10 cm. above the head of the cecum almost to the splenic flexure. A resection was done, which included a short segment of the terminal ileum, the cecum, ascending colon, and nearly all the transverse colon; the ileum was anastomosed to the splenic flexure. The patient made a fairly uneventful recovery, and left the hospital in much improved health.

The large segment of colon which was resected was thought to be carcinomatous until it was opened, when a very extensive polyposis was seen to be present. Figure 5 is a very good reproduction of the gross appearance of the specimen.

The report of the hospital pathologist, Dr. Frank Sturdivant, follows. "This specimen consists of a section of the bowel, including the distal 6 cm. of the ileum, and 36 cm. of the colon. The ileum and the ileocecal

Fig. 2. Six-hour distribution of barium meal, showing extensive filling defect in ascending and transverse colon.

Fig. 3. Twenty-hour distribution of barium meal, showing the whole course of constricted bowel from ascending colon almost to the splenic flexure.

valve were negative for pathology. The appendix, attached, is patent throughout and negative. The head of the cecum is dilated

FIG. 4. The result of a barium enema, showing barium and gas-filled bowel to a point proximal to the splenic flexure, and a narrow streak of barium in the transverse colon, corroborating the six- and twenty-hour findings.

for 10 cm., where there is a narrowing in the bowel lumen. At this point of narrowing the bowel wall measures 1 cm. in thickness, and the mucosa is polypoid in appearance. The polypoid mass is marked for a distance of 8.5 cm., but extends along the bowel wall for a distance of 18 cm. In several small pin-point areas it seems to have perforated the bowel wall. There are no glands in the attached omentum. Microscopically this is a section of the large bowel. The mucosa varies in thickness, and in places it is thrown up into papillary-like folds. The glands are normal in appearance. There is an infiltration of the mucosa with leucocytes, a great number of which are eosinophiles. The papillary folds show no tendency to fibrosis, and in no way resemble fibromas or adenomas. There is marked hypertrophy with hyperplasia of the submucosa and muscularis, the hypertrophy being marked in the muscularis. The serosa is somewhat thickened, and the vessels leading into it are sclerotic. No evidence of tuberculosis, carcinoma, or syphilis is present. Microscopically, the section is not that of a true polyposis, but one of a chronic colitis, due to inflammatory process."

About two months later the patient reentered

FIG. 5. Macroscopic appearance of the resected segment of colon, showing extensive polyposis, and great increase in thickness of the bowel wall.

the hospital for a further gastrointestinal roentgen study. The appearance of the stomach had not changed appreciably, and the anastomosis of the ileum to the splenic flexure of the colon was functioning well. She then left the hospital, only to return in November, 1927, very much weakened, very thin, unable to eat more than a very small amount at once, and in general showing such a marked change for the worse that death seemed not far off. A re-examination of her stomach was made roentgenologically, and it was found that the stomach was smaller than at the last examination, but otherwise showed a very similar appearance. The niche was present, and the filling defect in the greater curvature was a little deeper. The patient died in the latter part of December, and the following report of the autopsy findings in regard to the stomach is taken from the pathologist's record: "The stomach is bound down by adhesions on all sides, but more marked on the posterior surface. The stomach is contracted, and measures 12 cm. from the esophagus to the pylorus, and is 7 cm. in breadth. On section, the stomach walls are thickened, in places to 2.3 cm. The mucosa is injected, and there are flat polypi from the esophagus to the pylorus. On the posterior wall there is an

irregular punched-out crater-like ulcer, measuring 2 cm. in diameter. The crater extends through the muscular coat into the peritoneal coat. The ulcer edges are everted, and grossly they do not resemble carcinoma. The pyloric ring is thickened and hypertrophied. The duodenum for a distance of 5 cm. is dilated. Diagnosis: polyposis, and ulcer of the stomach."

For a masterly short discussion of the subject of intestinal polyposis, or colitis polyposa, the reader is referred to Ewing's Neoplastic Diseases. The literature contains fairly frequent reports of gastric polyposis, but reports of intestinal polyposis are exceedingly scarce in the literature of roentgenology.

In conclusion, it seems to me that from the standpoint of roentgenographical diagnosis, the most important point brought out in this case is that the great extent of a filling defect in the large bowel in itself argues against the presence of cancer, and further that it indicates the probability of the presence of polyposis. A second significant finding is that in spite of evidence of a rather high degree of obstruction, the passage of the barium meal through the colon is not delayed.

# THE VALUE OF CHOLECYSTOGRAPHY IN GALL TRACT DISEASE*

BY OSCAR C. ZINK, M.D.

Washington University School of Medicine

SAINT LOUIS, MISSOURI

PRIOR to the advent of gall-bladder visualization by the Graham-Copher-Cole method, the roentgenologic evidence of cholecystic disease was very scant and consisted chiefly in the visualization of gallstones having sufficient calcium to be opaque. In lesions of the gall-bladder without demonstrable stones, the roentgen film can only exceptionally furnish decisive evidence.

Occasionally gall-bladder shadows are seen due to the intrinsic density of their walls or the viscosity of their contents. Otherwise the roentgen manifestations alone are insufficient to support a diagnosis. The presence of indirect signs of gall-bladder disease necessarily involves chronic inflammation with adhesions. It is impossible for these signs to be present in an early cholecystitis in which only microscopical evidence of an interstitial or mucosal inflammation exists. Indirect signs are at times helpful, but Mills remarked that gall-bladder "secondaries" occur so seldom when actual gall-bladder disease is present, that when they do occur their value is questionable. In cholecystography we have a method that will give reliable information in these cases, and, as our interpretive acumen increases, they should be more readily recognized.

The diagnosis, then, of patients presenting themselves with gastric symptoms was a matter of exclusion. Carman has demonstrated gall-bladder shadows in cholecystectomized patients. Caldwell says: "If we only make enough films and make them well enough, we can obtain suspicious shadows in the gall-bladder region. The interpretation of gall-stone films becomes a matter involving not only skill and judgment but temperament as well." The personal equation of the observer is most important. This, I believe, is the best explanation of why some observers report as high as 85 per cent and others as low as 5 per cent positive findings in these examinations. The easiest thing to do is to read into the films something which is not there. The clinical indications of gallstones are fairly accurate, and stones are present in 50 to 60 per cent of the cases. About one-tenth will give reliable stone shadows, and of the other nine-tenths

* Read before the Central Section of the Illinois State Medical Society, May 18, 1926.

some of the films may show hazy, suspicious shadows. If we make a positive diagnosis of gallstones on these shadows, the operation will vindicate us in the majority of cases, and thereby cause us to over-estimate the help actually derived from the roentgen films. Clinical knowledge of the patient often leads us to accept these shadows, which might be found in the films of a normal patient, as evidence of gallstones.

The two methods of dye administration now chiefly employed are oral and intravenous. The latter is the method of choice in cases not presenting any of the following contraindications:

1. Obstruction of the common duct.
2. Extensive hepatic destruction.
3. Hypertension.
4. Cardiac disease, especially auricular fibrillation, or cases in which there is extensive myocardial damage.
5. Hyperthyroidism.

The diagnostic value in the oral administration is greatly decreased because of the attendant variable factors that must be given consideration before a definite opinion can be given. The amount of dye absorbed is dependent upon the dissolution of the capsules within the bowel and its absorption there. Thence it is probably carried to the liver through the portal circulation, and its entrance into, and elimination from, the gall-bladder is in the manner described after intravenous injection. A routine film should be made the morning of the examination to determine the presence, degree of disintegration and position of the capsules.

The presence of inflammatory disease in the small or large bowel may delay absorption or decompose the dye, or the small intestinal and colonic motility may be too rapid to allow sufficient time for absorption. The tendency to diarrhea is frequently present after oral administration, and this is augmented by the achylia and associated diarrhea often present in cases of cholecystitis. Capsules not infrequently disintegrate in the stomach, and are either vomited or combine with hydrochloric acid to form an insoluble acid salt. This method is only to be relied upon in cases presenting:

1. Normal shadow.
2. Presence of stones (negative or positive).
3. Topographical defects (pericholecystitis).

Questionable findings following oral administration should always be checked with the intravenous method.

For the past fifteen months we have been using a keratinized oral capsule containing 13 grains of sodium tetraiodophenolphthalein, 2 grains of sodium bicarbonate and 2 grains of agar. Five capsules are given with the evening meal, and films are made at fifteen, nineteen and twenty-three hours. The bicarbonate serves as a protective alkalinization in the event that the capsules disintegrate in the stomach, and the agar aids in the rupture of the capsules due to the absorption of water and subsequent swelling. Vomiting and the tendency to diarrhea have been almost entirely eliminated.

A few words about the new dye we have been using, differing only from the sodium tetraiodophenolphthalein in its structural make-up: it is phenoltetraiodophthalein, an isomer. The dosage intravenously varies between 2 and 2.5 grams, and can be given in one injection. Reactions are entirely eliminated and the normal shadows are slightly more intense. It has an added feature in that the alkalinized blood serum is deeply stained, and a liver function test can be done simultaneously. This valuable adjunct will save many diagnostic errors in those cases where the liver function is insufficient and as a consequence a normal amount of dye does not enter the gall-bladder.

Failure to secure a shadow in the presence of a standard intravenous technique indicates:

1. Cystic duct occlusion.
2. Hepatic insufficiency (atrophy, cirrhosis, etc.).
3. Small, sclerotic gall-bladder with obliterated lumen.
4. Cystic-lymphatic damage.

In the absence of any of the above conditions, the time of appearance, density and motility of the gall-bladder shadow are indirect indications of the pathologic condition of the mucosa. Topographical

defects, hour-glass contractures, dislocation of the fundus by extrinsic adhesions should be carefully checked by filming the patient in the erect posture in addition to the usual supine position. This method has saved the writer from committing interpretive errors in a number of cases in which there was a pressure deformity seen on all films due to position. Localization of tender points as arising from within or without the gall-bladder is also valuable.

A study of patients with reference to habitus, according to the work of Mills, shows that bodily type influences gall-bladder motility. Often an unusually long, persistent shadow is seen in asthenics, in which there is a general visceral hypotonia; whereas a rapid motility is frequently observed in hypersthenic types. The relationship between gall-bladder stasis in the former and subsequent cholecystic disease including the formation of stones, will doubtlessly form the most interesting chapter of gall-bladder disease in the future.

Of more importance is the time of appearance of the best shadow, and whether there is a general delay of the cycle. Our experience has been that the very early "strawberry types" of gall-bladders show a marked inhibition of the concentration phenomenon, and often only a delayed appearance of the shadow. We have become convinced through operatively confirmed cases that a gall-bladder whose shadow is faint or absent until the twenty-four hour period, will probably show microscopic, if not gross, evidence of mucosal pathology. The recent work of Graham and his associates has shown that the gall-bladder empties by means of a dilution of its contents. Dogs in whom the cystic duct was ligated after the production of a good shadow, retained it indefinitely. Animal experiments have also shown that peristalsis in the duodenum controls the opening and closing of the ampulla of Vater. The gall-bladder, being a comparatively passive organ, takes very little part in non-surgical drainage, and the common and hepatic duct biles are those chiefly recovered. Gall-bladder contraction is analogous to that which occurs when air is released from a toy balloon, i.e., a uniform reduction in size due to its inherent elasticity.

Clinical diagnosis of gall-bladder disease is never simple in a sense that there is a definite symptomatology, but each case presents a new, differential problem. The term "right upper quadrant" disease covers a large number of possibilities including chiefly gastric or duodenal ulcer, appendicitis with referred pain, spinal lesions, etc.

Cholecystitis can be divided clinically into four groups:

1. Cases in which attacks of biliary colic are the predominant feature with apparently healthy interim periods.

2. Cases in which stomach symptoms predominate, and the gall-bladder symptoms are of minor importance.

3. Cases in which the stomach and gall-bladder symptoms play an equal part.

4. Cases in which there is a general gastric indisposition over a period of years, and the gall-bladder is silent. The last group is the important one to recognize if we expect to make an early diagnosis of gall-bladder disease. Such patients go from place to place, having repeated roentgen examinations, test meals, etc., and often, unfortunately, are relegated to the "neurotic" class. Many cases of undiagnosed gastrointestinal disorders fall in this group, and it has been our experience that a patient returning some months or years following an appendectomy, complaining of the same symptoms for which he originally sought surgical relief, invariably has a demonstrable pathologic gall-bladder. When biliary colic manifests itself, the disease is well established and the chances for immediate or permanent relief are proportionately smaller.

In 1918 Graham pointed out that hepatitis is a constant accompaniment of cholecystitis. The picture is that of a pericholangitis, and if the inflammation persists a marked biliary cirrhosis is developed. Peterman later showed that the infection begins in the gall-bladder walls and not in the mucosa, and that the latter is very resistant to the introduction of bacteria present in the bile. Until the hepatitis disappears, symptoms following cholecystectomy may be as severe as

before operation. The solution is early recognition of gall-bladder disease and removal of the organ before a generalized liver infection takes place. Cholecystography as a functional test should acquaint us with the early manifestations of the disease, at which time there is a disturbance of function.

When we solve the problem of cholesterol precipitation within the gall-bladder, we will have made the first great step toward stone prevention. The concentration of cholesterol presumably bears little relationship to its ability to crystallize, for often a high concentration is found with no crystallization, and vice versa. The general complaint of biliousness with an icteric tint to the sclera is often met with, and the explanation is probably that of an atonic, sluggish gall-bladder, which favors bile stasis and absorption of some of its elaborated toxins, probably to be re-excreted by the already overworked liver cells. The value of non-surgical drainage is evident in these cases, and they constitute the largest percentage of its clinical applicability. Preventive measures applied here will materially decrease the subsequent number of chronic gall-bladder infections.

Since the inception of cholecystography, our percentage of correctness on operated cases microscopically examined at St. Luke's and Barnes Hospitals has been 97+ per cent. One source of error that is very difficult to control is the diagnosis of a normal gall-bladder in those cases that have had a definite cholecystitis, but have regained a normal function. These cases have clinical gall-bladder pictures, but a normal cholecystogram results. One case came to my attention in which operative gall-bladder drainage was done three years previously, and a normal cholecystogram followed. Subsequent removal showed definite microscopical evidence of disease.

In conclusion, let me again emphasize the value of cholecystography over the older methods of diagnosis, and encourage further investigation of gall-bladder function and dysfunction.

# CLINICAL DIFFICULTIES ENCOUNTERED IN CUTANEOUS ROENTGEN THERAPY *

BY GEORGE M. MACKEE, M.D.

Professor of Dermatology and Syphilology and Director of the Department of Dermatology and Syphilology, New York Post-Graduate Medical School and Hospital

NEW YORK CITY

THE difficulties that are peculiar to cutaneous roentgen therapy are too numerous even to mention in a short article. Only the troubles that are frequently encountered will be discussed and as the technical difficulties are well known, they will not be included.

Objectionable conditions that are characteristic of many skin diseases are often blamed on roentgen rays or radium by patients who have been judiciously treated with these agents. As a rule, such impression is original with the patient or is suggested by friends and relatives. Occasionally, however, it is suggested and supported by physicians who know little about dermatology or radiology. Not infrequently, erroneous impressions of this kind lead to legal action.

## COMPLICATIONS AND SEQUELAE OF DISEASES BLAMED ON IRRADIATION

1. Concomitants. Many skin diseases have concomitants that may be blamed on roentgen or radium treatment. As an example may be mentioned dermatophytide which often accompanies dermatophytosis. It may be mistaken for an exacerbation, extension, or a toxic rash caused by the treatment. Infectious eczematoid derma-

* Read at the Twenty-eighth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Montreal, Canada, Sept. 20–23, 1927.

titis accompanying discharging ulcers, sinuses, wounds, etc., may be included in this group.

2. Exacerbations. Spontaneous exacerbations occurring during the treatment of dermatoses such as eczema, dermatophytosis, neurodermatitis, etc., are common, annoying, and may appear to be due to the treatment.

FIG. 1. Atrophy and depigmentation due to spontaneous involution of angioma cavernosum. Such lesions often leave a rim of telangiectasia.

3. Topical Remedies. Irritating topical remedies used simultaneously with roentgen rays, will often cause alarming symptoms that may be blamed on the irradiation.

Examples. A patient received roentgen-ray treatment for psoriasis of the palms and soles. A 10 per cent chrysarobin ointment, applied to the palms, caused violent and persistent inflammation. The fact that there was no inflammation of the soles made it possible to convince the angry patient that the acute dermatitis was precipitated by the chrysarobin. In this connection, irritating topical remedies applied to an area of skin that has received a toleration dose of roentgen rays or radium, may cause an injury that is indistinguishable from a second or third degree radiodermatitis. A number of cases of this kind were published[1] in 1921.

[1] MacKee, G. M., and Andrews, G. C. Injurious combined effect of roentgen rays or radium, and topical remedies. *J. Am. M. Ass.*, 1921, lxxvii, 1489.

4. Complicating Affections. Occasionally, a patient who is being irradiated for a certain disease, will develop an additional affection.

Examples. A patient received the first of a series of fractional roentgen-ray treatments for generalized psoriasis. Two days later an acute dermatitis developed in the areas that had been irradiated. This was diagnosed radiodermatitis by the family physician, but it proved to be a typical case of dermatitis venenata. The writer has encountered many cases of this kind where the complicating eruption was dermatitis medicamentosa, dermatitis venenata, impetigo contagiosa, erythema multiforme, etc.

FIG. 2. Depigmented areas following treatment of psoriasis with topical applications—leucoderma psoriaticum.

5. Malingering. Dermatitis artifacta may resemble radiodermatitis. Malingerers are clever and if they have been irradiated for any purpose, it is difficult to differentiate between the affection and radiodermatitis. A good case of this kind, one that caused considerable perturbation, was published[2] in 1923.

6. Sequelae. A number of dermatoses, that are more or less amenable to roentgen

[2] MacKee, G. M., and Andrews, G. C. Dermatitis artifacta simulating roentgen dermatitis. AM. J. ROENTGENOL. & RAD. THERAPY, 1923, x, 617–622.

rays and radium, cause objectionable, disfiguring and even dangerous sequelae, which are often erroneously thought to be caused by the treatment, and which have been the basis of intense dissatisfaction and legal action. It is an important subject for discussion. The most common conditions are herewith appended and discussed.

FIG. 3. Atrophy and permanent alopecia occurring in an untreated case of lupoid sycosis—ulerythema sycosiforme.

Angiomata, especially the cavernous type, even after spontaneous cure, are likely to leave atrophy, scarring and telangiectasia, sequelae that resemble the so-called roentgen-ray or radium skin.

The lesions of psoriasis sometimes leave depigmented areas—leucoderma psoriaticum. While on the subject of psoriasis, it is well to bear in mind the fact that this disease may spontaneously change to dermatitis exfoliativa. Also, mycosis fungoides has been known to develop in cases that were diagnosed as psoriasis by excellent clinicians and pathologists.

The various types of sycosis, and chronic pyogenic folliculitis, may leave atrophy, scarring and permanent alopecia. Lupoid sycosis, and alopecia cicatrisata always cause permanent loss of hair and leave scars. Ulerythema ophryogenes is almost certain to cause more or less permanent alopecia. Keratosis pilaris is likely to effect punctate atrophy in adult life.

A number of dermatoses, especially lichen planus, may cause marked pigmentation that endures for many months. Keloids may leave depigmentation, atrophy and telangiectasia, a triad that resembles roentgen-ray skin. Farmer's skin or sailor's skin, developing in middle life, may be blamed on roentgen rays that were applied years previously.

Acne vulgaris may or may not leave pitted scars. Whether or not scarring occurs depends on many factors: duration,

FIG. 4. Atrophy and permanent alopecia caused by alopecia cicatrisata which was treated with sulphur ointment.

clinical type, severity, depth of lesions, character of skin, age, and innateness. Scarring is an exceedingly common sequel of this disease, and it is frequently severe and very disfiguring.

It has been claimed by many patients and by some physicians that scarring, as a sequel of acne vulgaris, is more common and more severe when roentgen rays are used than when they are not used. There is, at present, no convincing evidence in support of this contention. In fact, the evidence so far collected favors the assertion that roentgen-ray treatment lessens and prevents this sequel.

It is amazing how the skin of some patients will tolerate severe acne vulgaris for years with slight scarring. It is equally astonishing to observe marked scarring follow a comparatively mild example of the disease of short duration, irrespective of treatment. Scars are likely to be overlooked during the course of the affection

because of congestion, edema and the large number of pustules, comedones, papules, nodules, etc.; also, because the patient's mind is centered on the disease.

Before the advent of roentgen therapy scarring subsequent to acne vulgaris was blamed on curettage, incision, expression of comedones, topical remedies, arsenic by mouth, etc. The writer has observed worse

Fig. 5. Atrophy and permanent alopecia subsequent to favus.

and more frequent scarring without than with roentgen-ray treatment. It is his opinion that the best way to prevent scarring in this disease is to establish a cure as quickly as possible, and in many cases this cannot be accomplished without the aid of roentgen rays. Surprisingly severe scarring will occur in this disease even when there are no lesions other than comedones, and when roentgen rays are not employed.

Acne varioliformis, sometimes mistaken for acne vulgaris, almost always leaves pitted scars regardless of treatment.

It has been averred by patients and physicians that roentgen rays cause a growth of hair in cases of acne vulgaris. Hypertrichosis is never observed subsequent to roentgen-ray treatment of any other disease. Roentgen rays are useless for the treatment of alopecia. Excessive growth of hair is fairly common in cases of acne vulgaris of long standing, for which roentgen rays were not used. The overgrowth of hair is due, probably, to long-continued congestion of the follicles. It is barely possible that the persistent local application of stimulating remedies such as resorcin, sulphur, etc., may increase the amount of hair in susceptible persons. In

Fig. 6. Intense pigmentation following involution of lichen planus. No roentgen-ray treatment.

any event, there is no convincing evidence that so-called stimulating doses of roentgen rays can increase the growth of hair. Furthermore, fractional treatment consisting of $\frac{1}{4}$ erythema dose once weekly, by accumulation, is more likely to inhibit than stimulate.

Both lupus vulgaris and lupus erythematosus effect scarring and atrophy, and the latter causes telangiectasia. This false picture of chronic radiodermatitis is intensified by the fact that epithelioma is an additional sequel. It has been stated that these sequelae are more frequent since the

advent of roentgen therapy. This assertion may be true because in former years dosage was excessive. The point to be emphasized here, however, is that irradiation should not be blamed for untoward results of the disease.

It is believed by some that epithelioma is more likely to develop in leucoplakia as a result of radium treatment. With improper technique this may possibly be true, but evidence at hand supports the opinion that with proper judgment and technique, radium therapy reduces the incidence of epithelioma in this affection. Of course, the cases must be carefully selected.

FIG. 7. Scarring caused by acne vulgaris. Roentgen rays were not used.

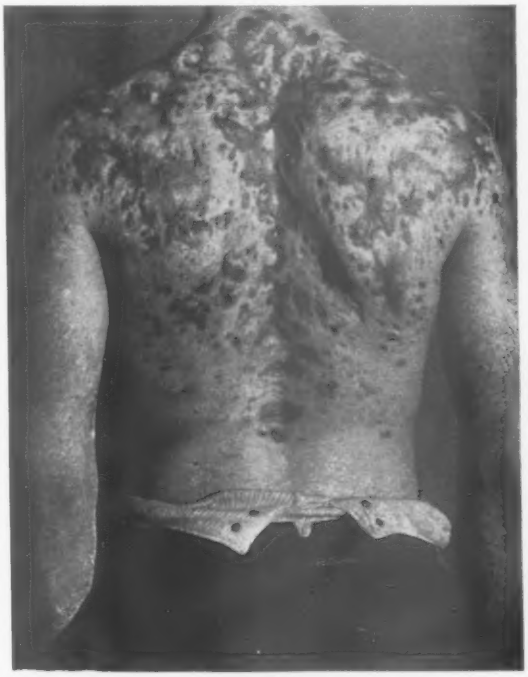

FIG. 8. Severe scarring subsequent to acne cachecticorum. No roentgen-ray treatment.

Kraurosis vulvae causes atrophy and sclerosis which should not be blamed on roentgen or radium treatment. This disease, as with all affections that cause atrophy or sclerosis, if irradiated for any purpose, must be handled with excellent skill and judgment. What was stated relative to epithelioma in leucoplakia pertains, also, to kraurosis vulvae.

### STERILITY

It occasionally happens that a man who has been irradiated for pruritus scroti, or for a disease of the scrotum such as eczema or psoriasis, discovers that he is temporarily or permanently sterile. Such a complication can be prevented, of course, by employing extremely long wave length roentgen rays, beta rays of very low velocity, very small doses of ordinary wave length roentgen rays, proper screening of the testicles, etc. The point to be particularly emphasized is that the patient may be sterile before irradiation. In order to prevent medicolegal complications it is a good idea to examine the semen before and at frequent intervals during treatment.

### ROENTGEN-RAY FAST ERUPTIONS

Psoriasis provides an excellent illustration of what is meant by a roentgen-ray fast eruption. Ordinarily, the recurring lesions of this disease will disappear as a result of a few fractional treatments. Occasionally, however, the eruption ceases to yield to any quantity of roentgen rays. This is especially likely to occur if the relapses are frequent and considerable treatment has been administered. As a preventive, it is advisable not to give more than half a

dozen fractional treatments, and not to employ roentgen rays when the disease is unyielding, or when relapses occur frequently. After an interval of perhaps a year, the disease may again respond normally to irradiation.

The resourceful dermatologist knows of many ways to overcome a roentgen-ray fast eruption. A long period of rest is

Fig. 9. Typical pitted scars of acne varioliformis. No roentgen-ray treatment.

perhaps the most valuable of all methods. Autoserum therapy, whole blood injections, injections of foreign proteins, heliotherapy, ultraviolet ray baths, together with proper topical remedies and general medical care, are successful in individual cases.

Much of what has been stated in regard to roentgen-ray fast psoriasis pertains, also, to affections such as dermatophytosis, neurodermatitis, eczema, mycosis fungoides, etc.

It is a wise plan to avoid roentgen-ray fastness and overtreatment. Most of the skin diseases that are amenable to roentgen and radium therapy will undergo involution as a result of a few, mild, widely spaced treatments. As a rule, nothing is gained and much is lost by attempting to force resolution with roentgen rays or radium. The operator should know the normal response for each disease. If good judgment in this respect is not used, the eruption may become recalcitrant to all forms of treatment, and irreparable injury to the tissues may result.

One must be especially careful, when

Fig. 10. Atrophy, depigmentation and telangiectasia in a case of lupus erythematosus.

treating generalized eruptions, not to lower the general resistance. Also, in some diseases, especially mycosis fungoides, too rapid resolution might be accompanied by toxic symptoms.

### STUBBORN BASAL CELL EPITHELIOMA

Some apparently favorable cases of basal cell epithelioma are exceedingly stubborn and a few cannot be cured with roentgen rays or radium. It is probable that such lesions are of mixed type; that is, derivation is partly from layers above the stratum germinativum. It has been estimated that about 10 per cent of basal cell epitheliomata contain prickle cells. In general, it is a good plan, in case a lesion fails to respond properly to the first intensive dose, to resort to some other form of

treatment, such as surgical excision or surgical diathermy.

### HIDDEN EVIDENCE OF EXCESSIVE TREATMENT

Dermatologists are occasionally surprised to note telangiectasia subsequent to treatment that was considered conservative and safe, and which did not appear to provoke erythema. Experience of this kind has led many to believe that telangiectasia may develop without an antecedent erythema. This opinion may be correct but it has not been proved. Roentgen or radium erythema, when occurring in inflamed skin is likely to be overlooked. The inflammation that masks the roentgen-ray erythema may be due to disease or it may be the result of topical applications. It is well to bear in mind, too, that congestion increases the biologic action of radiation. Cautious dermatologists avoid erythema except when intensive treatment is specifically indicated. In fact, many of them test the skin at frequent intervals for evidence of impending erythema.

Acne vulgaris may be used for an example. Assume absence of generalized hyperemia of the face. The patient is given $\frac{1}{4}$ erythema dose once weekly. At each visit the color of the face is noted in the standing and recumbent positions. The skin is frequently tested by pressure, by slapping, with heat, etc. Irritating topical remedies are avoided because they lessen toleration, and because the resulting hyperemia and desquamation may hide roentgen-ray erythema or premonitory evidence of toleration limits.

Erythema and even the early stages of severe radiodermatitis may be masked by a very thick horny layer. Verruca plantaris may be used as an illustration. Here, the first evidence of radiodermatitis, assuming that the lesion was closely shielded, is severe pain. This is followed by swelling, inflammation around the lesion, and eventually, by ulceration. The customary symptoms of mild reaction being absent, the operator is encouraged to administer additional treatment sufficient to effect a third degree radiodermatitis. The writer knows of many such instances.

### FAILURE TO CURE

Roentgen rays and radium are often unjustly blamed when a disease fails to improve, or gets worse, or new lesions appear, or another disease develops.

FIG. 11. Squamous cell epithelioma in a case of lupus erythematosus.

### SUPERVISION

The difficulties mentioned in this article indicate that the treatment of skin diseases with roentgen rays and radium should be conducted or supervised by a dermatologist. The intelligent use of these agents in this field requires a thorough training in cutaneous medicine of which physical therapy is an important part. Diagnostic ability is essential. It is important to know what dermatoses are amenable to roentgen rays and radium and what the therapeutic response should be. Such knowledge will do much to prevent useless or harmful treatment. If a disease fails to yield to these agents in a normal manner, they should be discontinued, and all the resources of cutaneous medicine employed to combat the affection. In fact, it is preferable to depend on these resources as much as possible in every case and from the beginning of treatment.

# DESIGN OF A WELL-PROTECTED RADIUM "PACK"*

BY G. FAILLA, D.SC.

Biophysical Laboratory, Memorial Hospital

NEW YORK CITY

## GENERAL CONSIDERATIONS

WHEN radium was first used therapeutically it was applied to the surface of the lesion to be treated in the form of tubes or flat plaques. As better knowledge of radium radiations became available and the results of radium treatments were analyzed, several improvements were gradually made. Thus the filtration was increased to 2 and even 3 mm. of lead, and the distance of application was increased from actual contact to several centimeters. The "cross-fire" idea suggested the use of multiple sources, and this led to the employment of flat applicators of fairly large area placed at a distance of several centimeters from the surface.

Development along these lines was more or less empirical in the absence of accurate knowledge as to the distribution of radiation within the irradiated volume. Nevertheless, progress was made and large radium "packs"* applied at distances up to 10 cm. were in use in this country more than ten years ago.† Following Friedrich's work on the distribution of roentgen rays in a water phantom, similar determinations were made for radioactive sources, and different arrangements could be compared experimentally.

We may now consider the factors which influence the design of a radium pack. In the first place, such an applicator is intended primarily for the treatment of deep-seated tumors. This means that sufficient radiation must be delivered to a considerable tissue depth to produce the desired effect. Furthermore, since in general the radiation must traverse some normal tissues before reaching the tumor, sufficient radiation must be delivered to the tumor without injuring seriously the intervening normal tissues. It will be seen, therefore, that the important thing is the ratio between the amount of radiation which falls on the skin and the amount which reaches a given tissue depth during the treatment. We may call the former the "skin dose" and the latter the "depth dose." Then by expressing the depth dose at any point in terms of the skin dose, we have the above mentioned ratio. We may call this the *relative depth dose*, and for convenience we may express it in percentage of the skin dose.

Without giving unnecessary details, we may now state that the relative depth dose at any given point in the irradiated tissue increases with (1) the filtration, (2) the area of the pack, and (3) the distance between the radioactive source and the skin. Other conditions being equal, it decreases, of course, as the tissue depth increases. The relation between the relative depth dose and these four factors (filtration, area, distance and depth) is not a simple one, but it can be obtained experimentally. It forms the criterion for the comparison of different radium pack arrangements.

General considerations, or a few experiments, will immediately show that the relative depth dose is always less than 100 per cent if "cross-firing" is not resorted to. This is always the case when the radioactive source occupies a small area ("point source"). When the radiating area is large, there is some cross-firing, or, in other words, the radiation which reaches the tumor passes through a larger skin area than in the case of the point source. But, nevertheless, the depth dose is always less than 100 per cent. This applies generally to all packs in which the skin receives radiation from all points of the radiating surface. It is with this type of applicator that we are chiefly concerned here, and the term "pack" in what follows will refer only to this type.

Certain radium applicators[1,2,3] have

* The writer believes that the term "pack" was introduced by Janeway in 1914, but it may have been used before by others. It is really unsatisfactory as a generic name for modern appliances. It is used here for lack of a better one.

† At the Memorial Hospital, New York City, and the Howard A. Kelly Hospital, Baltimore.

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been designed in which, by means of lead screens, the radiation is effectively limited to definite beams, all pointing in the direction of the tumor but entering through different skin portals (cross-firing). With these devices it is possible, *in some cases*, to deliver to the tumor more radiation than is delivered to any single skin area. An applicator of this sort consists really of two or more elements, each of which can be considered as a single pack. The rotating applicator of Stenstrom[4] may also be included in this class, although the separation of the different elements is not so complete nor so evident.

As already stated, a pack (as here defined) delivers depth doses which are always less than 100 per cent. It follows, therefore, that the only deep-seated tumors which can be treated successfully by such a pack (without resorting to cross-firing) are those which have a greater radiosensitivity than the skin or intervening normal tissues. Deep-seated tumors which are less sensitive than skin may be treated by applying the pack in more than one direction through different skin areas, provided the geometry of the part involved permits such procedure. Or pack treatments may be given to supplement radiation delivered to the tumor in some other way.

Given a radiosensitive tumor of a certain size at a definite depth, and knowing the relative susceptibility of the tumor with respect to the skin, it is possible (at least theoretically) to adjust the filtration, area, and distance of the pack so as to deliver to the tumor the proper dose of radiation without causing permanent injury to the skin. In general it is found, however, that unless the tumor is very radiosensitive and is close to the skin, the required conditions of application are impractical. That is, one or all of the three factors (filtration, area, distance) must be so large as to preclude the administration of the treatment with the amounts of radium ordinarily available—4 or 5 grams at the most. Furthermore, the relative radiosensitivities of different tissues, normal and pathological, are not definitely known at present. Lacking this information, it is impossible to determine the proper values of the filtration, area, and distance, which will give a satisfactory distribution of radiation within the irradiated tissue volume. From these considerations, it follows that the design of a radium pack cannot be based on the relative depth dose which one *must* have at a certain depth. For, in the first place, we do not know what the required depth dose must be for any particular tumor, and if we do know it, it is likely to be so high that treatments become prohibitive. Accordingly the design of a radium pack practically reduces itself to the problem of adjusting the filtration, area, and distance in such a way as to obtain the best depth distribution compatible with the practical limitations in the amount of radium available and the duration of the treatments. We shall consider, therefore, the influence of the three structural factors (filtration, area, distance) on depth doses.

It is well known that the higher the filtration the greater the depth dose, other conditions remaining the same. This is due to the fact that radium radiations are not homogeneous and that the filter intercepts to a greater degree the less penetrating components. The hardness of the transmitted radiation can be increased by additional filtration even after the rays have passed through 10 mm. of lead. But when depth doses in a light medium such as tissue (or water) are considered, it is found that additional filtration beyond 2 mm. of brass has practically no influence. On the other hand, the additional filtration decreases considerably the transmitted radiation, and consequently prolongs the treatment time. On this basis there is no advantage in the use of heavier filtration than 2 mm. of brass or its equivalent. It may be added here that a secondary filter of low atomic weight should be interposed between the brass and the skin, to remove the soft secondary radiations. This degree of filtration is generally accepted as necessary and sufficient for gamma-ray therapy. However it is sometimes claimed that better results are obtained by using filters of 2 or 3 mm. of lead or 1 or 2 mm. of platinum, on the basis that radiation thus filtered exerts a more "selective action" on cancer tissues. This point can hardly be said to be well established, and it is

doubtful whether the difference in "selectivity" due to the above changes in filter would be appreciable if it did exist. We may conclude, therefore, that the primary filter in a radium pack should be 2 mm. of brass or its equivalent.[5]

The second factor stated above which influences the relative depth doses is the *area* of the surface over which the radioactive source is distributed. We have so far made no reference to the shape of this surface (whether plane or curved) nor to the shape of the container (whether circular, square, rectangular, etc.). Obviously these variables must influence the depth doses, and especially the distribution of radiation over the skin and the irradiated volume. This is particularly true when the distance between the radium and the skin is small. However, we are chiefly concerned here with the design of a radium pack suitable for the treatment of deep-seated tumors, and in this case the radium skin distance must be rather large in order that a reasonable amount of radiation may reach the deeper layers of tissue. Under these conditions the shape of the radiating surface and its contour—within reasonable limits—are relatively unimportant. Let us assume, therefore, that the radioactive material is distributed over a plane surface.

Those familiar with roentgen-ray therapy know that the larger the port of entry, the larger the depth dose. The same holds true in the case of radium when used under similar conditions (i.e., when a small source at a considerable distance is used). This is due to an increase in the scattered radiation as the irradiated volume is increased. The improvement in the depth dose thus obtained is a real gain, since the time required to administer the desired skin dose is not prolonged, but is actually shortened. When a large radium applicator is placed at a distance of a few centimeters from the skin, we have in effect a large port of entry for the radiation. Relative depth doses are larger than when a small source at the same distance is used. But in this case the increase is not due to additional scattering. The chief cause is the utilization of a larger skin area for the rays, which travel directly from all points in the source to a given point in the tissue. This is clearly illustrated by the two diagrams of Figure 1. In both cases the line, AB, represents the extent of the skin area traversed by the rays which travel from the radium, Ra, to the point P. This line is much longer in (*b*), where the radium is spread over a larger area. Hence the quantity of radiation per square centimeter of skin (which determines the skin dose) is less in this case.

However, it is important to note that for the same milligram-hour dose more radiation reaches the point, P, when the radium tubes are close together, as in (*a*), than when they are spread out, as in (*b*). This is evident from the fact that all the connecting lines from Ra to P are shorter in the case of (*a*) than in (*b*); and that the distances traversed through tissue, where absorption takes place, are also shorter in (*a*) than in (*b*). Now the amount of radiation which reaches the skin directly over the point P is also greater in the case of (*a*) than in (*b*), because all the distances from the radium tubes are shorter. Accordingly with the distributed source both the skin dose and the depth dose are smaller when the same number of milligram-hours is considered. But it so happens that the decrease in the skin dose is relatively greater than the decrease in the depth doses, and consequently the percentage depth doses are greater in the case of the distributed source. Since the amount of radiation which reaches the skin (skin dose) is less for a distributed source, a larger number of milligram-hours must be used to deliver the same skin dose than in the case of a small source. It follows, therefore, that the increase in the relative depth doses is not a clear gain, as in the case of roentgen rays, but must be paid for by a prolongation of the treatment or the use of a larger quantity of radium. The employment of a large radiating area gives a large port of entry, but the scattered radiation is not increased appreciably because the intensity of radiation at any point is decreased.

From the preceding discussion, we may

conclude that it is desirable to distribute the radioactive source over a large* area in order to obtain larger relative depth doses. By so doing we obtain also a more uniform distribution of radiation within the irradiated volume *from the central axis outward*. This is particularly important when large tumors are to be treated. For these advantages we must pay the price in terms of additional milligram-hours.

Nothing has been said so far about the grouping of the radiating units (radium tubes) over the area we may have decided to use, but a uniform distribution has been tacitly assumed. Obviously this must have an influence on both the relative depth doses and the general distribution of radiation within the tissue irradiated. This is particularly true when the area is large and the distance between the radium and the skin is small. However, when the radium skin distance is comparable with the linear dimensions of the radium container, the grouping of the tubes has little influence on the doses at depths beyond a few centimeters, along the central axis. But with the idea of obtaining a more uniform distribution of radiation over planes parallel to the applicator, it is advantageous to use an increasing concentration of the radiating units from the center towards the periphery of the container.

We come now to the third and most important factor upon which the depth doses depend—the distance between the source and the skin. This corresponds to the target skin distance in roentgen-ray therapy. The problem, however, is much more complicated because in general we are not dealing with a "point source," but rather with sources which have linear dimensions larger than, or at least comparable with, the distance at which they are applied. For each particular source there is a definite relation between distance and relative depth doses, but we may say in general that the relative depth doses always increase with the distance. We may add also that the increase is most rapid for small sources (point sources) and becomes gradually less marked as the size of the radiating surface increases. The influence of distance on the depth doses delivered by the pack to be described here may be seen from the figures of Table 1, which show also the great advantage of long distances of application. Thus the relative depth dose at a depth of 10 cm. increases from 16.2 to 30.8 per cent as the distance is varied from 6 to 15 cm., other factors remaining the same.

From the preceding discussion we have seen that the relative depth doses increase with the filtration, area, and distance. We have already pointed out that there is no practical advantage in pushing the filtration beyond 2 mm. of brass or its equivalent; but so far we have arrived at no definite figures for area and distance. In order to do this, we must consider some additional factors which, while having no direct influence on depth doses, are very important from a practical standpoint. It has already been mentioned that the larger the area and the greater the distance, the larger must be the number of milligram-hours in order to deliver a given skin dose. The amount of radium available and the maximum desirable duration of irradiation, therefore, constitute two serious limitations. For instance, using 1 gm. of radium, filtered by 2 mm. of brass, distributed over an area of 70 sq. cm., and placed at a distance of 10 cm. from the skin, a continuous exposure of twenty hours is required to produce a threshold erythema. For a distance of 15 cm. the exposure would have to last forty-five hours. Whether treatments lasting twenty to forty-five hours, or longer, are possible, depends on the method of holding the radium in position and the type of case to be treated. Whether long continuous treatments are desirable depends on the relative biological effects produced in normal and cancer tissues by long and short treatments. In the absence of very definite information on this subject, the desirability or undesirability of long treatments depends on the particular radiotherapeutic views of the radiologist concerned. If long treatments are preferred, the method of applying the radium can be worked out accordingly, and a satisfactory arrangement can probably be found for

* How large the area should be depends on other considerations which we shall take up later.

most cases. It will be seen, therefore, that given a reasonable quantity of radium (500 mg. or more), there is a wide margin of variation for the factors which influence the depth doses, depending on the limits set for the duration of the treatment. At present this is largely a subjective matter.

Combining the amount of radium available and the maximum permissible duration of irradiation, we get the maximum milligram-hours available for any one treatment. It is naturally desirable to produce the greatest effect in a deep-seated tumor with this amount of available radiation without exceeding the skin tolerance. This means that the design of the pack should be such as to insure the highest depth doses while at the same time the skin receives a full dose with the available milligram-hours. This condition is essential because the highest *relative* depth doses are obtained when the radium is placed at a great distance from the skin (say 200 cm.), but with the available milligram-hours for one treatment, the skin would receive very little radiation. Hence the deep-seated tumor would receive a large percentage of a very small quantity of radiation, which means a very small dose. Since we have already assigned a definite value to the filtration (2 mm. of brass or its equivalent) the above condition must be fulfilled by the proper adjustment of the area and the distance. Theoretically these two factors could be varied considerably and still meet the requirement of delivering a full skin dose with the available amount of radiation. But, in practice, the type of case to be treated, the method of holding the pack, the question of protection for both technicians and patients, have a large influence on the choice of a particular area. Having done this, we immediately know the greatest distance we can use with the available radiation. It is always possible, of course, to use a shorter distance, according to the requirements of a particular case, and thus effect a saving in radiation.

### DESIGN OF MEMORIAL HOSPITAL PACK

Passing from the general to the specific, we shall now take up the design of our radium pack. In so doing, we shall also bring out some additional practical factors which must be taken into account. In our case it was decided first to use 4 gm. of radium (i.e., 4000 mg.). With this large amount of radium it was imperative to provide protection for the hospital personnel. Considering the great penetrating power of gamma rays, a lead-lined room for this purpose is out of the question. In addition, this would not afford protection to the operator while applying the radium. Therefore it was decided to place the protecting lead immediately around the radium.

The proper thickness to use depends on some unknown factors, and is largely a matter of judgment. To absorb gamma rays completely, probably a lead screen 20 cm. thick is required. This would make the container very heavy and cumbersome. Furthermore one always has the beam of rays which reaches the patient to contend with. Remembering that gamma rays are scattered in all directions by any matter in their path, it is evident that considerable radiation would be present in the neighborhood of a pack, no matter how much lead were used (partly) around the radium. It seems logical, therefore, to use such a lead enclosure for the radium as will reduce the primary radiation to a small fraction of the secondary and scattered radiation produced when the useful beam strikes the patient and neighboring objects. Just what thickness of lead is required for this purpose is difficult to say without more definite data about the actual construction of the protecting enclosure, the spread of the radiation beam, and the location of the radium with respect to the hospital personnel. In our particular case an additional factor had to be considered on account of the presence of 4 more grams of radium, making a total of 8 gm. in the hospital. The radon from 3.5 gm. of this radium is used throughout the hospital in some form or other, and those who spend a considerable time in the building receive some radiation therefrom. While the radiation from this radium and radon has proved harmless to the hospital personnel in general, we did not wish to increase it materially in view of the fact that the tolerance of the human body to such (more

or less) continuous irradiations is hardly known. Furthermore, the use of such a pack requires constant supervision by radiologists and technicians who must remain in its vicinity for considerable periods of time. Taking all these factors into consideration, it was decided to use a thickness of lead of 10 cm. as protection from the direct radiation. Measures were

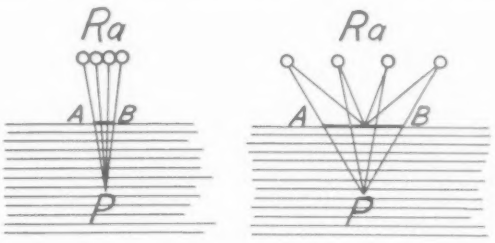


Fig. 1. Effect of distribution of radiating sources.

also taken to reduce the secondary and scattered radiation, as described later.

Using such a thickness of lead, it is obviously impossible to attach the pack to the patient, and an outside support had to be provided. This was designed with the idea of making the pack as "flexible" as possible, and making the orientation of the beam a simple and rapid process. The method of suspension we adopted is similar to the one we had previously worked out for roentgen therapy, and provides all the necessary motions to apply the beam of radiation in the desired manner.[6] Patients to be treated with this pack are brought to the radium room, instead of carrying the radium to different parts of the hospital.

While from the point of view of distribution of radiation within the tissues, it is desirable to use a large radiating area, there are certain limiting factors which cannot be ignored. From the clinical-radiological point of view, it is undesirable to irradiate intensely a large part of the patient's body while administering the desired dose to the tumor. This calls for the employment of a well-defined beam of radiation, which, while "covering" the tumor and probable extensions does not irradiate too large a volume of normal tissues. The cross-section of the therapeutic beam, therefore, should vary according to the size of the tumor and its location.* In our case, however, it was decided to use a beam which would be suitable for the average deep-seated tumor to be treated with the pack. We may point out in this connection that a large amount of radon is always available at the hospital, and that this can be used in special applicators to meet particular requirements.[7] After careful consideration by the clinicians at the hospital and the writer, it was decided to distribute the radium over a circle 7.5 cm. in diameter and to limit the beam to a skin area 10 cm. in diameter.† The desire to use a limited beam gives an additional reason for the use of a lead enclosure around the radium.

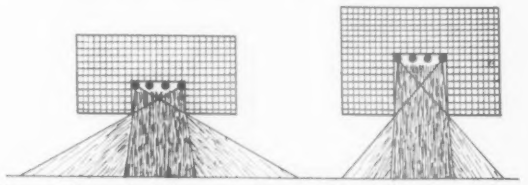

Fig. 2. Spread of beam and penumbra effect according to depth of radium in lead container.

It is well known that cross-firing is very effective and economical when a large amount of radiation is to be delivered to a deep-seated tumor. The smaller the beam, the more suitable it is for this purpose because more ports of entry can be used. However, if only a small beam is available, the cross-fire method must be employed for the treatment of practically all deep-seated neoplasms, not only in order to obtain greater depth doses, but also in order to irradiate uniformly fairly large tumors. The cross-section of the beam of our pack is large enough to cover the majority of centralized tumors, still it is not so large as to interfere seriously with cross-firing. The *circular* cross-section of the beam is convenient for many treatments, since localized tumors are more or less round in shape. But it is not so convenient for the treatment of very large or widely disseminated tumors and for close cross-firing. With a square or rectangular cross-section overlapping can be avoided more easily *provided the square or rectangle*

* The location is important in cases where radiosensitive organs adjacent to a tumor might be injured.

† This is strictly true for two distances, 6 and 10 cm., as will be seen from the cross-section of the pack.

*can be oriented properly*. It is not a simple matter to fulfill this condition and we therefore adopted a circular beam.

The proper administration of a treatment with a heavy pack which cannot be carried by the patient, demands that the latter remain practically immobile after the appliance has been adjusted in the desired position. How long a patient may

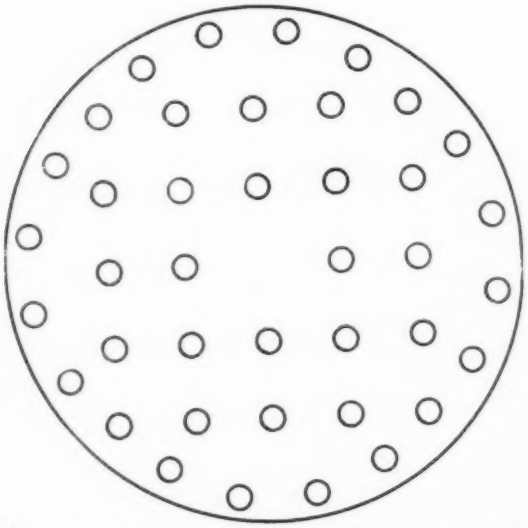

Fig. 3. Arrangement of 40 radium tubes within a circle 7.5 cm. in diameter.

reasonably be expected to remain in proper juxtaposition to the pack depends on the condition of the patient and the part to be treated, but obviously it is always a question of a few hours at the most. As an average figure, let us take three hours. Therefore, with 4 gm. (4000 mg.) of radium in the pack, we have available 12,000 mg-hr. for the average uninterrupted irradiation. In order to administer an erythema dose with our pack in one continuous treatment of three hours, it is necessary that the distance be 6 cm. or less. This, of course, does not give the upper limit for the distance at which our pack can be used, for we have arbitrarily limited the duration of the treatment to three hours. Naturally, even in the course of twenty-four hours several three-hour treatments can be given to the same patient over the same area, with suitable rest periods in between. Accordingly it is possible to administer an erythema dose within a day, using a considerably greater distance than 6 cm. In our case, therefore, 6 cm. is not the maximum distance at which the pack can be placed, but rather the distance for which an erythema dose can be administered continuously during the average time that a patient may be expected to remain in a more or less fixed position. From the point

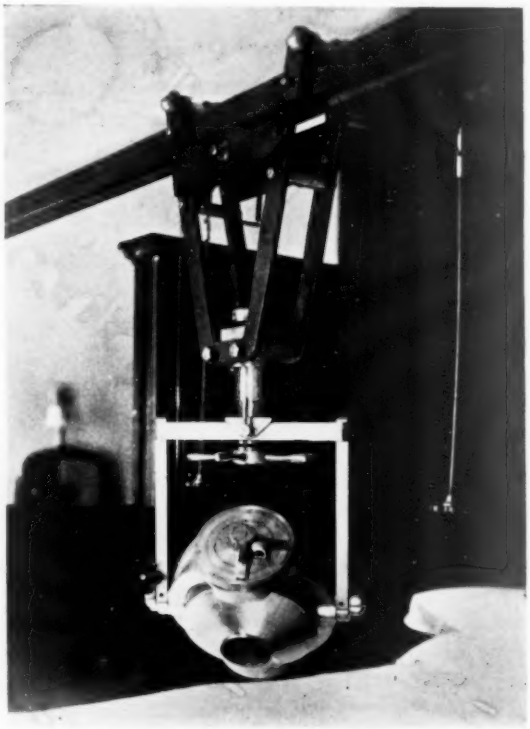

Fig. 4. Photograph of radium pack and method of suspension.

of view of personnel protection, it is desirable to place the radium in the lead container as deeply as possible. This is evident from the schematic drawings of Figure 2, in which it will be seen that the spread of the radiation beam is much greater for the shallower container. The depth at which the radium is placed determines the minimum radium-skin distance which can be used with the pack. In our case we decided that a shorter distance than 6 cm. was not necessary since other radium is available for treatments at shorter distances, and the radium was placed at this depth in the container. The minimum distance which can be

used with our pack, therefore, is 6 cm., and as we have seen, an erythema dose can be administered in three hours under these conditions.

*Description of Apparatus.* The radium is in the form of radium sulphate in forty platinum capsules, each containing 100 mg. of radium (element). The capsules are short cylinders with flat ends so that they

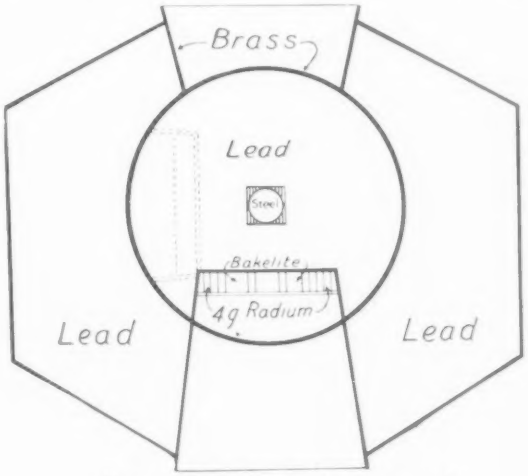


FIG. 5. Cross-section of radium pack.

can be used endwise. The wall thickness is 0.35 mm. throughout except for the gold-soldered cap, which is 0.5 mm. thick. The distribution over a circle 7.5 cm. in diameter is shown in Figure 3, the capsules being inserted into suitable holes in a bakelite disc. It will be seen that the spacing around the periphery is closer than in the central portion. This was done for the purpose of obtaining a more uniform distribution of the radiation within the tissue. The bakelite disc with the forty radium tubes constitutes the "radiating surface" with an area of 44 sq. cm.

A photograph of the container and its mounting is given in Figure 4. A cross-section through the points of support is shown in Figure 5. The heavy circle in this figure represents a lead cylinder 15 cm. in diameter and 28 cm. long, weighing 55 kilograms (120 pounds). One side of this cylinder has been milled out at its midpoint in the shape shown to form a receptacle for the bakelite disc. The latter is held in place by a central screw (not shown). A brass sleeve 1.5 mm. in thickness surrounds the whole cylinder to protect the lead from mechanical injury. A steel shaft is provided along the axis of the cylinder, which is thus supported on ball bearings within a large lead casting. The longitudinal section of this casting is shown in Figure 5 in its proper relation to the inner cylinder. It consists of a central cylindrical portion, capped by conical ends with tapered

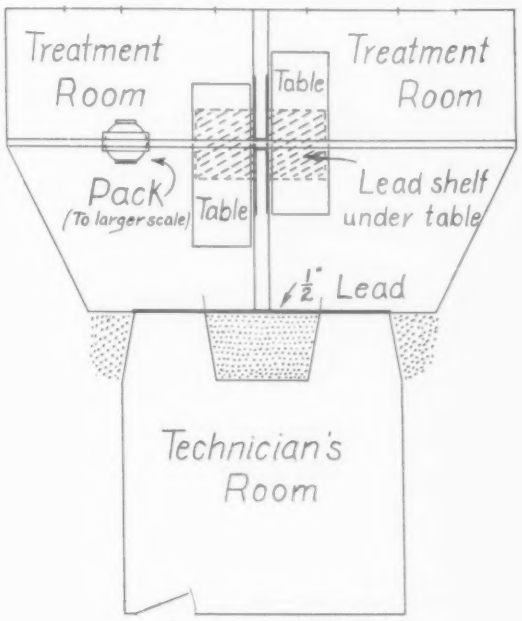


FIG. 6. Room layout.

recesses as shown. These recesses provide ports for the useful radiation to pass through. The inner and outer cylinders are at right angles to each other, but their relative position is such that one recess is deeper than the other. By rotating the inner cylinder on its axis the radiating surface may be made to register with either port, the radium being at a depth of 6 cm. in one case and 10 cm. in the other. A brass housing is provided for the external lead cylinder also, to prevent damage, facilitate mounting, and improve appearance of the appliance. The heavy contour lines in Figure 5 indicate the brass lining.

It may have occurred to the reader that it is not really necessary to have two separate ports for the useful radiation. Naturally with the shallower recess it is possible to use radium skin distances of 6

or more centimeters by proper adjustment of the pack over the patient. The inclusion of two ports is due to our desire to provide as much lead protection as feasible. In the first place, it was decided that provision should be made for shutting off the useful beam of radiation while the pack is being adjusted to a patient and during the time that it is not in use. It is for this reason

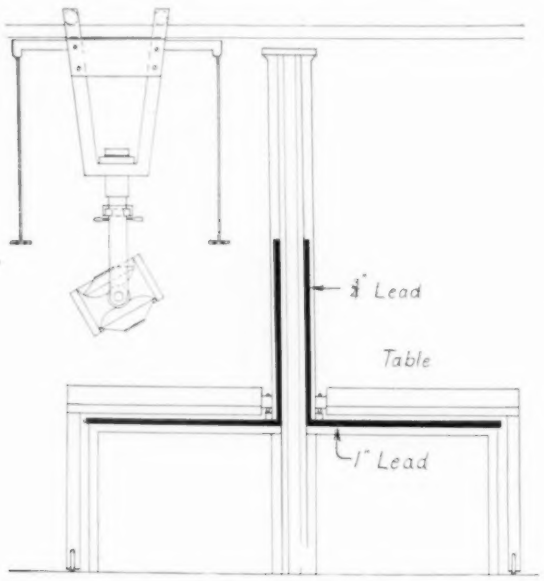


Fig. 7. Cross-section through partition separating two treatment rooms. Note arrangement of protective lead with respect to usual position of pack.

that the inner cylinder mounted on ball bearings was included in the design. It will be seen that by rotating this through 90°, the radiating surface moves to the position shown by the dotted lines in Figure 5, and that the radium is completely surrounded by lead. Having provided for the angular displacement of the radiating surface on this account it was a simple matter to provide an additional port. The two ports make possible better protection of the hospital personnel, and also variation of the size of the radiation beam, within certain limits. Greater protection is obtained because for treatments at distances of 10 or more centimeters the radium can be at a depth of 10 cm. in the container, thus reducing the spread of the beam, as previously explained and illustrated in Figure 2. Variation of the beam area is obtained by using either the 6 or the 10 cm. recess for distances greater than 10 cm. The two recesses are so constructed that the external opening is 10 cm. in diameter in both cases. Since the radiating surface is 7.5 cm. in diameter, it follows that the taper of the 6 cm. recess is greater than that of the 10 cm. recess. For the same radium skin distance of 10 cm. the deeper recess irradiates an area 10 cm. in diameter, whereas the *geometrical* beam of the shallower one covers an area nearly 12 cm. in diameter. The actual radiation beam in the latter case is even larger, on account of the penumbra effect due to the size of the radiating surface (see Fig. 2 and compare A and B of Fig. 8).

The lead container as described weighs about 140 kilograms (310 pounds). A strong bronze casting is therefore used to encircle the lead in its brass housing, in order to provide suitable supports for the inner cylinder and rigid studs for the suspension of the pack in a steel yoke, as shown in Figure 4. The inner cylinder can be rotated by a handle (shown in Fig. 4) which serves also to indicate the position of the radiating surface with respect to the openings (in Fig. 4 it is pointing downward). Stops are provided for the working positions. The mounting of the bronze ring permits complete rotation of the pack in its yoke so that either opening may be used at the desired angle. The yoke is attached to a steel frame by means of a heavy stud which permits it to rotate, thus providing the additional angular motion for the proper orientation of the radiation beam. The steel frame forms a carriage which runs on a horizontal beam for lateral motion of the pack. The horizontal beam (24 ft. long) extends across the room and is suspended from two strong screws (3 cm. in diameter and 125 cm. long) which are mounted vertically. The two screws are geared together across the room so that both may be turned synchronously by a ¾ H.P. motor provided for the purpose. The motor is electrically reversible and may be operated by a hand switch on a flexible cable. In this way it is possible to raise or lower the pack and accessory mechanism weighing about 250 kilograms (550 pounds) without effort.

Provision was made also for raising or lowering the pack by hand by means of the hand wheel shown in Figure 4. However, it was found in actual operation that the appliance could be brought to the desired height very accurately by using only the electric drive.

Safety measures are provided to cut off the power supply if for any reason the motor should continue to lower the pack after it comes in contact with the patient. For this purpose, the hand switch cable is attached to the wall plug which supplies the current to the motor. The operator can cut off the power supply by pulling the switch cable. Quicker action may be obtained by pressing both the "up" and "down" buttons in the hand switch, in which case the supply fuses will blow out. In our experience with this mechanism, which we have used for controlling roentgen-ray tube holders during the last two or three years, it has never been necessary to resort to these measures.

In order to have the greatest latitude in the adjustment and orientation of the radiation beam, both in the case of a radium pack and a roentgen-ray tube holder, three independent linear motions and three independent motions of rotation must be provided. We have seen that the pack can rotate around two axes perpendicular to each other. Rotation around a third axis is not necessary in this particular case because the radiation beam has a circular cross-section.* Two rectilinear motions have already been described, up and down, and from one side of the room to the other. The third one, at right angles to these two, is obtained by running the treatment table on longitudinal tracks. By the use of suitable roller and ball bearings the adjustment of the pack requires very little effort. Clamping devices are provided to maintain the chosen adjustments during a treatment.

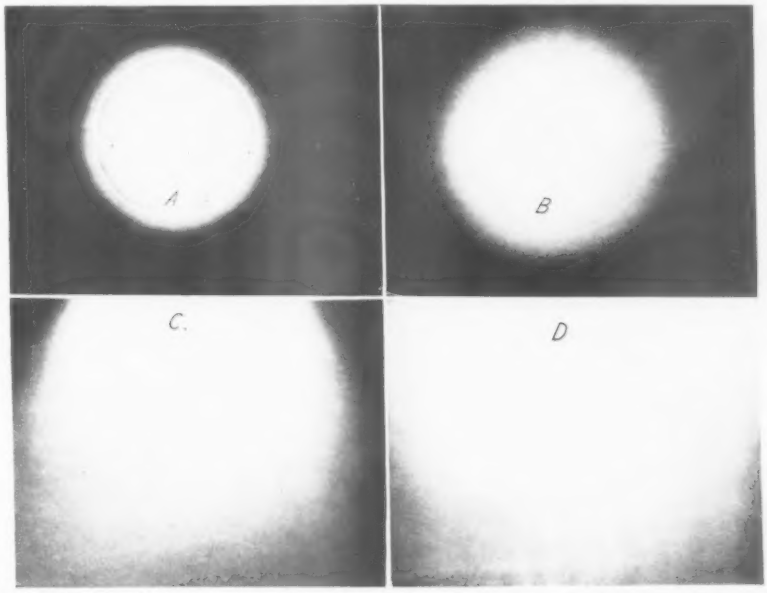


FIG. 8. Photograph showing relative size of radiation beams from 10 and 6 cm. recesses, other conditions being equal.

On account of the value of the radium and the demand for its use, it was decided to provide two treatment tables separated by a partition. In this way, before one treatment is completed another patient can be gotten ready on the adjoining table. It is then simply a matter of passing the pack through an opening in the partition and of adjusting it to the new patient. At the same time the first patient can dress at his leisure in the other room. With this arrangement an ordinary set-up

* A circular beam was adopted to avoid the mechanical complication of providing the third motion of rotation. This complication is more serious than it appears at first thought.

can be made in three minutes. The pack is in almost continuous operation from 7 A.M. to 11 P.M., with an efficiency of utilization during this time of 90 per cent or better.

Figure 6 shows the room layout,* and Figure 7 a cross-section of the central partition and treatment tables. The point of chief interest here is the arrangement

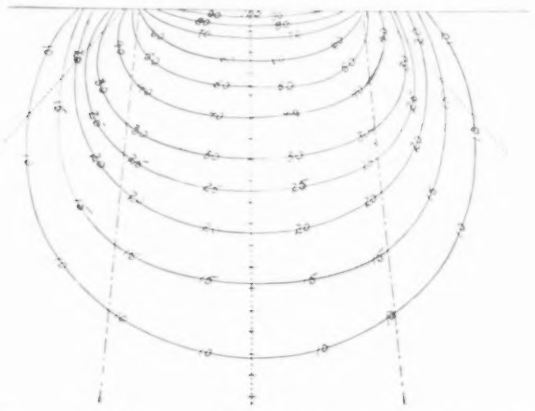

FIG. 9. Distribution of radiation in a water phantom. Radium skin distance 10 cm., using 10 cm. recess of pack.

of the lead installed for the purpose of reducing the scattered radiation. It will be noted that, as the pack is ordinarily used, the beam of rays falls within the heavy lead angles and is absorbed to a considerable extent by this lead before it strikes the floor or walls of the room. A certain amount of radiation is scattered by this lead, and some of the radiation which passes beyond the lead angles is scattered by the floor or any matter in its path. For this reason lead is also provided on the doors and the wall separating the treatment rooms from the technicians' room (Fig. 6). Small windows are provided in the lead-lined doors so that the patient may be observed from time to time to make sure that he remains in the proper relative position with respect to the pack throughout the treatment. The windows have lead trap doors, partly balanced so as to remain closed at all times except when lifted by an observer. The technician is required to look at the patient every fifteen minutes at the strike of a clock provided for this purpose.

* The room was not built for this purpose, and the particular shape of the side walls has no significance.

*Physical Characteristics of the Radiation Beam.* The minimum filtration for the rays which reach the patient is 0.35 mm. of platinum and 1.5 mm. of brass. This is sufficient to remove all the primary beta rays and the softest components of the gamma rays. The average filtration is considerably greater on account of the fact that the radium tubes are placed

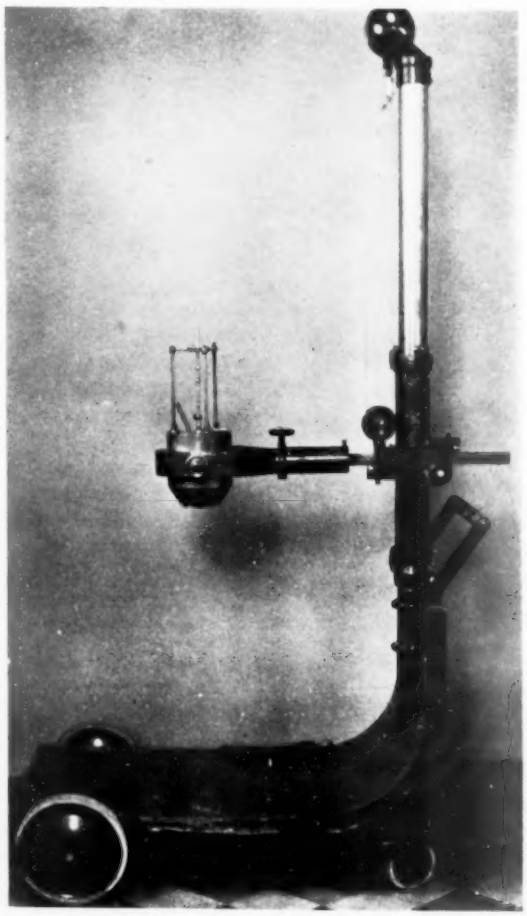

FIG. 10. Portable pack in which radon is used as the source of radiation.

with their axes in the direction of the useful beam, and also on account of the curvature of the brass filter (see Fig. 5). Some of the rays must pass through a considerable thickness of radium sulphate—which is a good filter—and some rays which emerge transversely along the cylindrical part of the capsules must traverse a considerable thickness of platinum (and bakelite). It should be noted in this connection

that no matter how a radium tube is placed, the filtration is never identical for all rays which form the useful beam. With the endwise arrangement used in our pack, however, the inequality in filtration is greater than if the tubes were placed sidewise. While this is disadvantageous in some respects, it tends to increase the relative depth doses, because it offers more obstruction to the rays which do not travel in the desired direction. We may add here that the radium tubes were made short for this purpose, the height of the radium salt being about 8 mm. The addition of a brass filter is desirable, since it is known that brass emits little secondary beta radiation. The particular thickness used (1.5 mm.) and its position (around the lead cylinder, Fig. 5) were governed by structural requirements. A secondary filter consisting of 1.5 mm. of bakelite, is provided at the rim of each recess.

To visualize the shape of the radiation beam, roentgen films were exposed under different conditions. Reproductions of four films are given in Figure 8. Film A was placed over a large block of paraffin and the pack was adjusted so that the brim of the 10 cm. recess was in actual contact with the film envelope. The sharp outline of the beam as it emerges from the pack under these conditions is evident. Film B was exposed under similar conditions except that the 6 cm. recess was used. In order to obtain the same radium film distance as for film A, film B was at a distance of 4 cm. from the brim of the 6 cm. recess. Under these conditions the projection of the geometrical beam on the film should be 12 cm. in diameter, as shown by the circle marked on the film. However, the penumbra effect previously mentioned (see Fig. 2) gives a beam considerably larger than 12 cm., and gradually fading in intensity beyond this circle. Films C and D were exposed between paraffin blocks to get an idea of the spread of the radiation beam in an absorbing and scattering medium, comparable to human tissues. The radium paraffin distance was 10 cm., but for film C the 10 cm. recess was used, while for film D the 6 cm. recess was employed. It will be seen that in neither case is the beam sharply outlined, and that the one from the 6 cm. recess is considerably larger and more diffuse than the beam from the 10 cm. recess. This is to be expected for two reasons: (1) the penumbra effect due to the fact that the source is not a point but a circle; (2) the scattering of radiation in all directions, which takes place when gamma rays pass through matter. It is

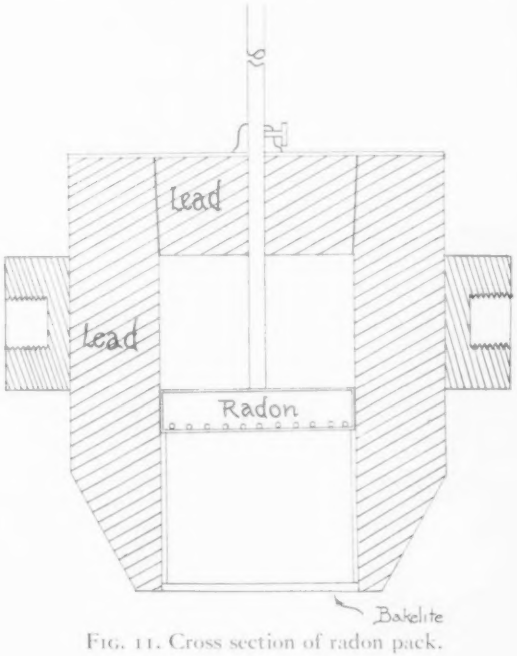


FIG. 11. Cross section of radon pack.

therefore impossible to obtain a sharply outlined beam of gamma rays within the patient's body. The fact that the beam from the 10 cm. recess is sharper, justifies in itself the provision in the pack of two recesses of different depths.

Figure 9 shows the distribution of radiation in a water phantom determined by means of a small ionization chamber.* The measuring instrument has been described in previous publications from this laboratory.[5] The water phantom is 30 × 35 × 30 cm. The distribution chart given was obtained with the beam of rays emerging from the 10 cm. recess when the radium-water distance was 10 cm., in which case the brim of the recess just touched the surface of the water. From such a chart it is possible to tell

* These and other measurements were made by Edith H. Quimby, and will be reported more fully later.

not only that the beam is not sharply limited within the water, but also what the relative intensity of radiation is at different points. The dot-and-dash lines in the chart represent the extension of the conical recess, and the dotted lines the extreme outline of the geometrical penumbra.

It should be noted that the isodose lines are not straight even within the main beam, indicating that the intensity of radiation is not quite uniform from the central axis outward. The decrease of intensity near the periphery, however, is not large. Variations occur even at the surface, and the intensity at the edges of the field is 60 to 70 per cent of the intensity at the center, in the particular case of Figure 9. Since the pack is used for the treatment of deep-seated tumors, this is no disadvantage except insofar as the skin dose is limited by the effect produced in the central portion of the irradiated area. On the other hand, reasonable overlapping of fields on the skin when cross-firing is employed is not serious under these conditions.

TABLE 1

MILLIGRAM-HOURS REQUIRED TO PRODUCE THRESHOLD ERYTHEMA FOR DIFFERENT RADIUM SKIN DISTANCES

| Mg-hr. | 12,000 | 17,000 | 24,000 | 37,000 | 47,000 | 78,000 |
|---|---|---|---|---|---|---|
| Radium Skin Distance | 6 Cm. | 8 Cm. | 10 Cm. | 12 Cm. | 15 Cm. | 20 Cm. |
| Depth, Cm. | Relative Depth Doses | | | | | |
| 0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 1 | 75.0 | 76.5 | 77.8 | 80.0 | 85.8 | 93.0 |
| 2 | 61.5 | 63.5 | 65.2 | 67.5 | 74.4 | 86.0 |
| 4 | 42.5 | 44.2 | 46.8 | 51.4 | 59.2 | 73.0 |
| 7 | 25.0 | 27.2 | 30.3 | 34.5 | 43.0 | 56.0 |
| 10 | 16.2 | 18.2 | 20.7 | 24.3 | 30.8 | 43.0 |
| 15 | 8.7 | 10.2 | 11.8 | 14.7 | 19.4 | 28.0 |
| 20 | ..... | ..... | 6.7 | 9.5 | 13.6 | 21.0 |

It is of interest to compare the relative depth doses obtained with different radium skin distances. The figures given in Table 1 were determined by means of the small ionization chamber and the water phantom previously mentioned. Taking the 10 cm. depth as an example we find that the dose at this depth varies from 16.2 to 43 per cent of the surface dose as the distance changes from 6 to 20 cm. At the same time it will be seen (at the top of the table) that the milligram-hours required to administer the same skin dose vary from 12,000 to 78,000 for the above range of distance. Accordingly, to increase the dose at a 10 cm. depth $\frac{43}{16.2}$ or 2.7-fold, the exposure must be increased $\frac{78{,}000}{12{,}000}$ or 6.5 times. This gives a measure of the price we must pay to obtain high depth doses when a single field is used. If the geometry of the part to be treated makes possible cross-firing with three separate fields, a dose of ($3 \times 16.2 =$) 48.6 per cent can be delivered to a 10 cm. depth by three applications of the pack at a 6 cm. distance. In this case the total milligram-hours required would be ($3 \times 12{,}000 =$) 36,000, or less than one-half the number required for the single application at a distance of 20 cm. We do not wish to convey the idea by this example that the two modes of administering a certain amount of radiation to a given tissue depth are equivalent. For instance, the distribution of radiation within the irradiated tissues is entirely different in the two cases. We wish to point out, however, that whenever the geometrical and clinical conditions of a case permit, cross-firing is more economical.

From the preceding discussion, it is evident that the physical characteristics of the beam of radiation to be employed play an important part in the administration of radiation. In practice a cross-section of the part to be treated is made on tracing cloth and the treatment factors are determined by trying different arrangements with distribution charts provided for this purpose. The number of fields and the respective radium skin distances are determined in this manner for each case. The combined doses received by different parts of a tumor are recorded on the cross-section chart.*

* This work is done by Dr J. J. Duffy, who is in charge of the pack.

## CONCLUDING REMARKS

Protected packs which on account of their weight cannot be strapped to the patient are not new. A small contrivance of this sort, with a plunger arrangement for varying the position of the radium, and hence the spread of the beam, was used a few times at the Memorial Hospital in 1916 or 1917. Other arrangements have been described by Chambers, Russ, and Lazarus-Barlow,[9] Burnam and Ward,[10] Stenstrom,[4] Lysholm,[11] Coliez and Mallet,[12] Sluys and Kessler,[1] Bruzau and Ferroux.[13] All these packs vary as to shape and size of the beam, thickness of lead, and other details. Whether one is better than another depends largely on the work which it is intended to do. The pack we have described is not intended for the administration of *all* external radium treatments. Some cases are best treated by radium plaques, dental compound, or wax moulds, trays, etc. For some cases it is preferable to take the radium pack to the patient rather than the patient to the pack room. For such cases we have an adjustable portable pack as shown in Figures 10 and 11. Our large pack is perhaps unique as regards the large thickness of protective lead employed, the device for "turning off" the radiation beam while the pack is being adjusted, the method of raising and lowering the heavy container, and the provision of two adjacent rooms in which the pack may be used alternately.

Realizing that the use of a pack of this sort is indicated only when a large amount of radium is available, a general discussion of the physical factors involved in the treatment of deep-seated tumors by external radium applications has been included in this paper. It is hoped that this may prove of some value to those who wish to design special applicators to meet their individual needs. Additional information will be found in the publications referred to in the text.

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# A STUDY OF RESISTANCE TO TUMOR RE-IMPLANTATION IN RATS CURED OF CANCER BY RADON*

BY KANEMATSU SUGIURA, D.M.SC., AND STANLEY R. BENEDICT, PH.D.

NEW YORK CITY

DURING recent years much interest has developed concerning radium therapy in the treatment of malignant neoplasms. Numerous clinical studies have shown beyond a doubt that in certain types of tumors radium treatment is followed by regression of the growth and apparent cure of the malignant disease. Obviously it is of interest to determine whether tumor regression and absorption following radium treatment confers upon the treated animal any immunity to the development of a new-growth. The present work was planned to answer this question in relation to the transplantable Flexner-Jobling rat carcinoma.

Several reports have already appeared concerning the immunity-conferring power of tumor tissue previously treated *in vitro* with radiation. Thus Contamin[1] found that mice inoculated with tumor cells (a glandular carcinoma of the mouse) which had been exposed to roentgen rays for a short period were made immune to the same tumor, but a long exposure destroyed the immunizing power. Similarly Wedd, Morson and Russ[2] have shown that the inoculation of the Twort mouse carcinoma (irradiated *in vitro* by the beta rays from radium bromide) into mice, conferred a considerable amount of immunity against subsequent inoculation. Prolonged irradiation of the tumor cells, however, greatly diminished this immunity-conferring power. Chambers, Scott and Russ[3] made a careful study on the nature of the immunizing action of irradiated tumor tissues. They report a considerable degree of immunity in animals after the subcutaneous inoculation of the tumor tissues (Jensen rat sarcoma and rat sarcoma F 16) which had been subjected to a lethal dose of roentgen rays or of radium radiation. They also pointed out that the absorption of the irradiated tumor tissue inhibited the growth of already established tumors. Lazarus-Barlow and Parry[4] found that previous inoculation with the Jensen rat sarcoma heavily irradiated with roentgen rays induced some protection against a subsequent inoculation with the same tumor. Sugiura and Benedict[5] have shown that inoculation into animals of cancer cells previously killed by ultraviolet radiation did not alter the susceptibility of the animals to tumor transplants (Flexner-Jobling rat carcinoma and Bashford mouse carcinoma No. 63). Wood and Prigosen[6] have made an extensive study on the inoculability of tumors (Flexner-Jobling rat carcinoma, Jensen rat sarcoma and mouse sarcoma No. 180) in albino rats and mice previously sensitized by the subcutaneous injection of roentgen irradiated tumor. They found that in secondary implantations no apparent difference existed in the takes between the treated and control animals. Recently Mottram[7] found that chickens in which the Rous chicken sarcoma had undergone absorption after irradiation from radium bromide filtered through silver exhibited resistance to subsequent inoculation with the tumor.

## EXPERIMENTAL PART

The Flexner-Jobling rat carcinoma was selected for the present study because of its regularity and high percentage of successful tumor takes.* The tumor grafts grow progressively and rapidly. Many of them reach the size of a walnut before ulceration. They show only occasional spontaneous absorption, such cases being about 15 per cent of the positive transplants.†

When about 5 mg. pieces were inoculated subcutaneously in the region of the axilla these transplanted tumors may grow in spheres or in ovoid shapes‡ during the

* From the Huntington Fund for Cancer Research, Memorial Hospital and the Harriman Research Laboratory, the Roosevelt Hospital.

* It was found that there was almost always from 80 to 100 per cent of tumor takes in healthy young adult albino rats of our inbred strain.

† Tumors growing over three weeks in the animals are regarded as positive transplants.

‡ The longer diameter of the tumor is in the longitudinal axis of the body.

first two or three weeks. Later they generally become flat at the body side and convex on the skin side. As the tumors grow larger in size, they become soft, due to central degeneration and necrosis. Later the tumors ulcerate, usually about ten weeks after the implantation, though sometimes as early as in the fourth week, and subsequently cause the death of the animals from septicemia and nutritional failure.

The tumor materials* were selected from solid and non-ulcerated tumors of from fourteen to fifty days old, growing normally in young adult white rats. The animals were fed a normal diet consisting of white wheat bread, milk and lettuce.

Two types of radium radiation (beta and gamma rays) were employed in the present study. The source of the beta rays was radon (radium emanation) in capillary glass tubes, 3 mm. long and 0.3 mm. in diameter. Since the wall thickness of the glass tubes containing the radon is about 0.1 mm., the radiation emitted is largely of the beta ray type. The gamma rays were obtained from radon in gold tubes, 5 mm. long, and 0.5 mm. in diameter. The thickness of the gold tubes is 0.3 mm. which filters out more than 99 per cent of beta rays.[5]

In order to distribute the radiation uniformly to all portions of the tumors, the radon tubes were inserted into the central part of the tumors by a small trocar placed at an angle of about 45° to the surface of the tumor. However, when two or more radon tubes were used (in the larger tumors), the radon tubes were inserted perpendicularly near the periphery of the tumor since the central portion of the large Flexner-Jobling rat carcinoma shows extensive central necrosis.

Our preliminary experiments indicated that if the radon tubes (each tube being 2 mc. of initial strength) were allowed to remain in the tumors (each tumor being about 10 mm. in diameter) for a period of fourteen days, the tumors regressed and disappeared as completely as though the radon tubes were left in permanently. Insertion of tubes without radon into the tumors showed neither inhibiting effect upon the primary tumors nor upon the growth of secondary implants. Since the initial strengths of these radon tubes used were relatively small, the beneficial effect from the residual amounts (less than 1 per cent of its original strength) at the end of thirty days was negligible, as our preliminary experiments indicated. Therefore we have made no attempt to remove the buried tubes from the tumors, but they were left *in situ* permanently.

The results obtained from inserting the glass capillary tubes containing radon into the tumors of various sizes are given in Table 1.

In this table are included all the negative observations, so that some relationship between the amount of radiant energy in term of millicuries to size of the tumor, the unit of which is arbitrarily fixed as 1 sq. cm. of surface area, might be deduced.

In the second column of the table the size of the tumors is denoted by the measurements of lengths and widths. The thickness of the tumors is generally less than the width, but is omitted on account of less accurate measurements. In the table the complete absorption of the tumors is indicated by a plus sign; while continuation of the tumor growth is indicated by the negative sign in the fourth column. In the last column we have given a brief account of the irradiated tumors.

It is evident from the results shown in Table 1 that the beta rays emitted from radon caused a very large percentage of the tumors to retrogress. Retrogression usually begins during the first week and the tumors disappeared completely in about fifty days. A few of the irradiated tumors underwent a rapid absorption, disappearing in less than twenty-two days. Even in many of the negative cases, the tumors remained stationary or actually diminished in size during the first two weeks after irradiation, but they later resumed normal growth. Occasionally there was an increased rate of growth of malignant tumors after inadequate irradiation.

In attempting to establish a minimum curative dose for a tumor on the basis of the results presented in Table 1 we meet certain difficulties. Thus there is appar-

* In the present experiments we used from the 118th to 158th transplantation generations of the Flexner-Jobling rat carcinoma.

TABLE 1

THE EFFECTS OF RADIATION FROM UNFILTERED RADON UPON THE GROWTH OF RAT CARCINOMA

| Exp. No. | Surface Dimension of Tumor, Mm. | Initial Strength of Tube, Mc. | Results of Irradiation | Remarks |
|---|---|---|---|---|
| 1 | 4.0 × 4.0 | 0.39 | + | Tumor slowly retrogressed; complete absorption in 22 days. |
| 2 | 4.2 × 4.0 | 0.15 | + | Tumor slowly retrogressed; complete absorption in 32 days. |
| 3 | 4.5 × 4.5 | 0.05 | − | Tumor growth stopped; then rapid growth. |
| 4 | 4.8 × 4.5 | 0.23 | + | Tumor slowly retrogressed; complete absorption in 28 days. |
| 5 | 6.0 × 3.7 | 0.59 | + | Tumor slowly retrogressed; complete absorption in 43 days. |
| 6 | 5.0 × 4.8 | 0.59 | − | Tumor continued to grow and ulcerated. |
| 7 | 6.0 × 5.8 | 1.02 | + | Tumor slowly retrogressed; complete absorption in 40 days. |
| 8 | 6.0 × 6.0 | 1.02 | − | Tumor growth stopped for 12 days; then continued to grow; later ulcerated. |
| 9 | 6.2 × 5.9 | 0.59 | + | Tumor slowly retrogressed; complete absorption in 50 days. |
| 10 | 6.2 × 6.2 | 1.02 | + | Normal growth for 7 days; then slowly retrogressed; complete absorption in 61 days. |
| 11 | 6.5 × 6.2 | 1.07 | + | Tumor slowly retrogressed; complete absorption in 85 days. |
| 12 | 6.5 × 6.5 | 2.68 | + | Tumor slowly retrogressed; complete absorption in 59 days. |
| 13 | 6.2 × 7.0 | 0.55 | + | Tumor slowly retrogressed; complete absorption in 50 days |
| 14 | 7.0 × 6.7 | 1.07 | − | The growth of tumor stopped for 24 days; then resumed growth. |
| 15 | 7.0 × 6.8 | 1.55 | + | Tumor grew normally for some time; then slowly retrogressed; complete absorption in 90 days. |
| 16 | 7.0 × 7.0 | 0.2 | + | Tumor slowly retrogressed; complete absorption in 21 days. |
| 17 | 7.5 × 6.9 | 1.03 | + | Tumor slowly retrogressed; complete absorption in 28 days. |
| 18 | 7.0 × 7.5 | 0.11 | + | Tumor continued to grow for 21 days; then slowly retrogressed; complete absorption in 47 days. |
| 19 | 7.6 × 7.0 | 2.30 | + | Tumor slowly retrogressed; complete absorption in 39 days. |
| 20 | 7.4 × 7.2 | 0.55 | − | Tumor growth was stopped for 52 days; then resumed growth. |
| 21 | 8.0 × 7.0 | 1.11 | + | Tumor slowly retrogressed; complete absorption in 86 days. |
| 22 | 7.5 × 7.5 | 0.11 | + | Tumor slowly retrogressed; complete absorption in 36 days. |
| 23 | 8.0 × 7.2 | 1.13 | + | Tumor slowly retrogressed; complete absorption in 40 days. |
| 24 | 7.8 × 7.8 | 1.02 | − | Retarded tumor growth for a while; then rapid growth; later ulcerated. |
| 25 | 7.7 × 7.9 | 1.02 | + | Tumor slowly retrogressed; complete absorption in 42 days. |
| 26 | 7.5 × 8.3 | 0.59 | + | Tumor slowly retrogressed; complete absorption in 43 days. |
| 27 | 8.5 × 7.5 | 1.09 | + | Tumor slowly retrogressed; complete absorption in 58 days. |
| 28 | 8.5 × 7.8 | 0.48 | + | Tumor slowly retrogressed; complete absorption in 53 days. |
| 29 | 8.5 × 8.0 | 0.48 | + | Tumor slowly retrogressed; complete absorption in 48 days. |
| 30 | 8.8 × 7.9 | 0.48 | − | Tumor slowly retrogressed; apparent absorption in 27 days; then reappeared at base of a scab. |
| 31 | 8.3 × 8.4 | 0.59 | + | Tumor slowly retrogressed; complete absorption in 43 days. |
| 32 | 8.5 × 8.5 | 2.08 | + | Tumor slowly retrogressed; complete absorption in 68 days. |
| 33 | 8.5 × 8.8 | 1.13 | − | Tumor growth retarded for 18 days; then resumed growth and ulcerated. |
| 34 | 8.9 × 8.4 | 1.45 | − | Tumor growth stopped for 28 days; then resumed growth and ulcerated later. |
| 35 | 8.8 × 9.0 | 2.49 | + | Tumor slowly retrogressed; complete absorption in 20 days. |
| 36 | 9.0 × 8.9 | 2.56 | + | Tumor slowly retrogressed; complete absorption in 17 days. |
| 37 | 9.2 × 9.0 | 0.55 | − | Tumor slowly retrogressed; apparent complete absorption in 28 days; a tumor reappeared 12 days later and continued to grow. |
| 38 | 10.8 × 8.5 | 0.11 | − | Tumor continued the growth; later ulcerated. |
| 39 | 10.5 × 9.0 | 0.11 | − | Tumor continued the growth; later ulcerated. |
| 40 | 10.5 × 9.5 | 0.2 | − | Tumor growth retarded for a short time, then resumed growth and ulcerated. |
| 41 | 9.5 × 11.5 | 1.76 | + | Tumor slowly retrogressed; complete absorption in 48 days. |
| 42 | 11.0 × 10.5 | 2—2.08 | + | Tumor slowly retrogressed; complete absorption in 45 days. |
| 43 | 11.3 × 11.0 | 1.1 | − | Tumor growth stopped for 2 weeks; then normal growth. |
| 44 | 11.6 × 11.5 | 2.15 | + | Tumor slowly retrogressed; complete absorption in 45 days. |
| 45 | 12.5 × 12.0 | 0.066 | − | Tumor grew very rapidly, and ulcerated. |
| 46 | 12.9 × 12.0 | 0.066 | − | Tumor grew very rapidly, and ulcerated. |
| 47 | 13.0 × 12.0 | 3—2.08 | + | Tumor slowly retrogressed; complete absorption in 61 days. |
| 48 | 13.2 × 12.1 | 0.51 | − | Stopped the tumor growth for 31 days; then rapid growth. |
| 49 | 13.4 × 12.5 | 3.42 | + | Tumor slowly retrogressed; complete absorption in 50 days. |
| 50 | 13.5 × 12.5 | 2—1.76 | − | Tumor retrogressed for 17 days; ulcerated; then rapid growth. |
| 51 | 13.5 × 12.8 | 0.26 | − | Tumor growth stopped for 17 days; then rapid growth. |
| 52 | 13.7 × 13.0 | 7.5 | + | Tumor slowly retrogressed; complete absorption in 70 days. |
| 53 | 14.5 × 12.5 | 1.76 | − | Tumor retrogressed for 28 days; then resumed normal growth. |
| 54 | 14.5 × 14.0 | 2—1.75 | − | Tumor ulcerated soon after insertion of tubes; but growth continued. |

+ indicates cure of tumor; − indicates continued growth of tumor.

Table 1 (*Continued*)

| Exp. No. | Surface Dimension of Tumor, Mm. | Initial Strength of Tube, Mc. | Results of Irradiation | Remarks |
|---|---|---|---|---|
| 55 | 14.0 × 14.5 | 0.21 | + | Tumor slowly retrogressed; complete absorption in 101 days. |
| 56 | 17.0 × 16.5 | 5.5 | − | Tumor quickly ulcerated; tumor growth continued until death of animal. |
| 57 | 17.5 × 18.5 | 0.11 | − | Tumor continued to grow and ulcerated. |
| 58 | 17.0 × 19.2 | 0.21 | − | Tumor continued to grow normally and ulcerated. |
| 59 | 17.5 × 21.0 | 2—2.86 | + | Tumor retrogressed and ulcerated; complete absorption in 65 days. |
| 60 | 19.5 × 20.0 | 4—1.11 | − | Tumor ulcerated; animal died 49 days later; healthy tumor tissue at the periphery. |
| 61 | 21.0 × 20.0 | 0.11 | − | Tumor continued to grow and ulcerated. |
| 62 | 20.0 × 21.5 | 2.85 | − | Tumor growth stopped for 11 days; then rapid growth and ulcerated. |
| 63 | 22.5 × 22.5 | 0.11 | − | Tumor continued to grow and ulcerated. |
| 64 | 22.5 × 23.2 | 3—2.52 | + | Tumor retrogressed and ulcerated; complete absorption in 65 days. |
| 65 | 23.2 × 24.3 | 6.0 | − | Tumor continued to grow and ulcerated. |
| 66 | 39.8 × 32.5 | 5—2.15 | + | Tumor retrogressed; complete absorption in 37 days. |

+ indicates cure of tumor; − indicates continued growth of tumor.

ently different radiation sensitiveness for different tumors. The tumors 125th generation, series D (experiment numbers 16, 23, 28, 30, 33, 40, 55 and 58), 126th generation, series A (experiment numbers 7, 8, 10, 24 and 25), 126th generation, series D (experiment numbers 11, 13, 14, 20, 34 and 37), and 127th generation, series E (experiment numbers 18, 22, 38, 39, 61, 63 and 65) illustrate the irregular character. Here the general conditions except the transplantation generation are nearly identical, yet the radiation sensitivity of the tumor tissues varies greatly. Thus tumors 125th generation, series D, and 127th generation, series E, required much smaller doses of radiation for the complete inhibition of growth than tumors 126th generation, series A and D. Natural resistance in the individual animals may well have some influence upon the radiation sensitivity of the tumor. It is thus evident that the reaction is not clear cut. However, plotting a few minimum effective values given in Table 1, we may be able to draw a curve denoting a rough relationship between the size of a tumor and the minimum destructive dose of radon. The surface area of the tumor is expressed in square centimeters.

It will be seen in Figure 1 that the relation is nearly direct so that with the increase in the size of the tumor a relatively greater initial dose of radon is required.

Another point of interest in connection with the present study is the effect of the disintegration products of the tumor tissue on the nutrition of the hosts. Contrary to our expectation, the general condition of the animals whose tumors were regressing was good. The animals either kept gaining or maintained body weight.

As a result of the mode of application of the radon tubes, the following reactions were produced in the skin over the tumor when a sufficiently large dose of radiation was used: erythema, inflammation, alopecia, ulceration, serous exudate, sloughing and scar.

It is a general opinion that both gamma and beta rays from radon have an equally destructive effect upon cancer cells, but the gamma rays produce a less intense necrosis than do the beta rays. We therefore carried out some experiments similar to those reported in Table 1 in which the radon was in gold tubes, so that gamma radiation was obtained. The results are presented in Table 11.

As in the case of the beta radiation, the destruction of the malignant tumors was easily accomplished by the gamma radiation emitted from radon. Thus essentially the same millicurie values, one in a glass tube and the other in a gold tube, had nearly the same therapeutic effect.

It is, however, interesting to note that the average time required for the complete

TABLE II

THE EFFECTS OF RADIATION FROM FILTERED RADON UPON THE DEVELOPMENT OF RAT CARCINOMA

| Exp. No. | Surface Dimension of Tumor, Mm. | Initial Strength of Tube, Mc. | Results of Irradiation | Remarks |
|---|---|---|---|---|
| 1 | 6.7 × 6.0 | 0.6 | + | Tumor slowly retrogressed; complete absorption in 46 days. |
| 2 | 6.2 × 7.0 | 1.1 | + | Tumor slowly retrogressed; complete absorption in 69 days. |
| 3 | 7.0 × 6.8 | 0.55 | + | Tumor slowly retrogressed; complete absorption in 69 days. |
| 4 | 7.8 × 7.1 | 1.1 | + | Tumor slowly retrogressed; complete absorption in 69 days. |
| 5 | 7.7 × 8.0 | 0.55 | + | Tumor slowly retrogressed; complete absorption in 76 days. |
| 6 | 8.8 × 8.3 | 1.65 | + | Tumor slowly retrogressed; complete absorption in 80 days. |
| 7 | 12.5 × 11.6 | 2.42 | + | Tumor slowly retrogressed; complete absorption in 94 days. |
| 8 | 12.0 × 12.7 | 0.60 | − | Tumor continued retrogression for 21 days; then resumed normal growth. |
| 9 | 13.0 × 11.9 | 1.65 | + | Tumor slowly retrogressed; complete absorption in 73 days. |
| 10 | 14.1 × 16.0 | 2—2.1 | + | Tumor slowly retrogressed; complete absorption in 55 days. |
| 11 | 16.1 × 14.5 | 2.75 | + | Tumor slowly retrogressed; complete absorption in 135 days. |
| 12 | 17.1 × 14.1 | 2—2.75 | + | Tumor slowly retrogressed; complete absorption in 149 days. |
| 13 | 16.2 × 15.8 | 0.50 | − | Tumor growth stopped for 7 days; then resumed normal growth. |
| 14 | 17.0 × 15.8 | 2—2.75 | + | Tumor slowly retrogressed; complete absorption in 60 days. |
| 15 | 17.1 × 15.8 | 2.75 | + | Tumor slowly retrogressed; complete absorption in 61 days. |
| 16 | 23.6 × 23.0 | 7.73 | − | Tumor continued regression for 52 days; then resumed normal growth. |
| 17 | 29.8 × 29.0 | 10.4 | − | Tumor continued regression for 38 days; then resumed normal growth. |

+ indicates the cure of tumors; − indicates the continued tumor growth.

absorption of the irradiated tumors following use of the gold tubes was eighty days, against fifty days for those treated with the glass tubes. Our finding corroborates the observation of Cutler[9] upon healthy tissue of rabbits, in that the lesion produced by a glass tube containing radon was chiefly one of complete necrosis, whereas that following use of a gold tube was largely that of partial necrosis.

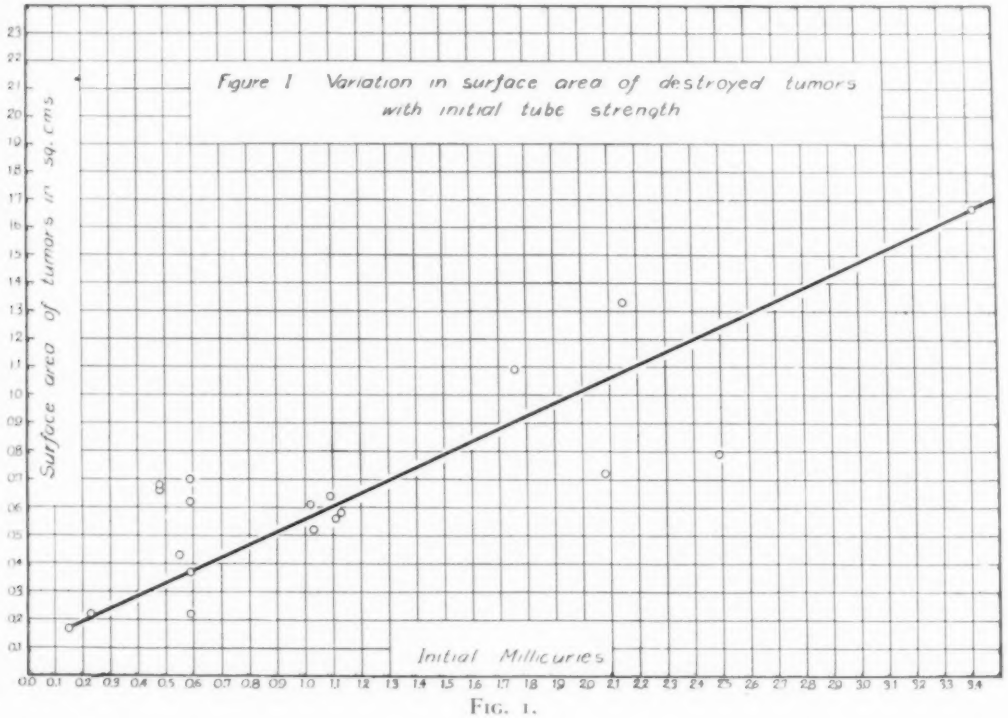
Figure 1 Variation in surface area of destroyed tumors with initial tube strength
Surface area of tumors in sq. cms
Initial Millicuries

FIG. 1.

TABLE III

RESULTS OF TUMOR RE-IMPLANTATION IN RATS WHOSE PRIMARY TUMORS HAVE BEEN COMPLETELY ABSORBED AFTER IRRADIATION WITH $\beta$ OR $\gamma$ RAYS OF RADON

| Exp. No. | Surface Area of Absorbed Tumor Sq. Cm. | Kind of Filter Used | Interval between the Absorption of the Primary Tumor and Secondary Implantation Days | Growth of Second Implants |
|---|---|---|---|---|
| 1 | 0.16 | glass | 7 | − |
| 2 | 0.17 | glass | 2 | + |
| 9 | 0.37 | glass | 5 | − |
| 10 | 0.38 | glass | 1 | − |
| 11 | 0.40 | glass | 14 | + |
| 12 | 0.42 | glass | 76 | + |
| 13 | 0.43 | glass | 49 | + |
| 15 | 0.48 | glass | 90 | − |
| 16 | 0.49 | glass | 21 | + |
| 18 | 0.53 | glass | 8 | − |
| 19 | 0.53 | glass | 1 | − |
| 22 | 0.56 | glass | 22 | − |
| 23 | 0.58 | glass | 20 | − |
| 25 | 0.61 | glass | 1 | + |
| 26 | 0.62 | glass | 1 | + |
| 27 | 0.64 | glass | 58 | + |
| 28 | 0.66 | glass | 7 | − |
| 29 | 0.68 | glass | 91 | − |
| 31 | 0.70 | glass | 1 | + |
| 32 | 0.72 | glass | 77 | − |
| 35 | 0.79 | glass | 19 | + |
| 41 | 1.09 | glass | 28 | − |
| 42 | 1.16 | glass | 100 | + |
| 47 | 1.56 | glass | 84 | − |
| 52 | 1.78 | glass | 50 | − |
| 55 | 2.03 | glass | 7 | − |
| 64 | 5.22 | glass | 44 | + |
| 66 | 12.94 | glass | 1 | − |
| 1 | 0.40 | gold | 7 | + |
| 2 | 0.43 | gold | 10 | + |
| 3 | 0.48 | gold | 21 | − |
| 4 | 0.55 | gold | 14 | + |
| 5 | 0.62 | gold | 28 | + |
| 6 | 0.73 | gold | 21 | + |
| 7 | 1.45 | gold | 7 | + |
| 10 | 2.26 | gold | 7 | − |
| 11 | 2.33 | gold | 1 | + |
| 12 | 2.41 | gold | 1 | − |
| 14 | 2.69 | gold | 1 | + |
| 15 | 2.70 | gold | 1 | + |

The animals in which absorption of the tumor had been induced by radon were employed for the re-inoculation experiments. The re-inoculations were made with the Flexner-Jobling rat carcinoma at periods from one day to one hundred days after complete absorption of the primary growths. The second pieces of the tumor tissue were inoculated in the region of the axilla, on the opposite side from the primary implantation, and the number of takes compared with controls inoculated with the same tumor.

The results are summarized in Table III. In this table the number of experiments and the size of the absorbed tumors correspond with those tabulated in Tables I and II. Some transplants proliferate in the animals for several days; but if they are completely absorbed within fourteen days they are considered as negative transplants.

It would seem from these experiments that the absorption of the cancer cells following the use of beta rays has induced some protection against the subsequent growth of new cancer cells. The state of active acquired resistance appears to remain for a long period. Of the 28 "cancer-cured" animals, 16 failed to take the secondary implants, or 57 per cent negative. This figure represents 45 per cent below the normal tumor resistance percentage. On the other hand, the absorption of the cancer cells following the action of gamma rays apparently did not protect the animals from the secondary implantation, since 75 per cent of transplants were positive. The number of animals in this experiment is, however, too limited to warrant drawing definite conclusions upon this point.

In a previous paper[10] we have stated that destruction of the already growing tumors, or protection against subsequent implants, was the result of inoculation with living cancer cells. However, the present study indicates that under the stated condition of irradiation, the absorption of inactivated tumor cells has a similar immunity conferring power. This is more evident if we select the animals whose tumors have been progressively absorbed following the action of very small doses of radon. In 6 animals, namely, experiment numbers 16, 18, 22, 28, 29 and 55 (Table I), only one took the secondary implant. In these it appears that the relatively small tumor tissue necrosis, as evidenced by less degeneration of cancer cells (which was produced by the very weak tubes), gave rise to certain antagonistic substances. This assumption is strengthened by the fact that the immunizing property of the absorbed cancer cells does not appear to be a function of the amount of tumor tissue

absorbed, since a small amount (about $\frac{1}{500}$ of the weight of the animal) exhibited the immunizing property as well as that from a large amount (about $\frac{1}{5}$ of the weight of the animal).

We have not determined whether the absorption of disintegrated normal cells when the healthy tissue of rats has been subjected to a lethal dose of radium radiation will protect against subsequent tumor inoculation. Experiments upon this point will be carried out later.

## SUMMARY

The question as to whether the absorption of the tumors following the action of the intratumoral implantation of radon tubes gives rise to tumor immunity was investigated.

Destruction and absorption of the Flexner-Jobling rat carcinoma follow exposure to the beta or gamma rays emitted from radon. The average time required for the complete absorption of the irradiated tumors by the former was fifty days, whereas by the latter it was eighty days.

There exists a certain relationship between the size of the tumors and the initial tube strengths, so that the amount of tumor destruction appears to depend largely upon the amount of radiant energy absorbed by the tumor tissue.

Following the use of beta radiation it was found that there was moderate protection against the subsequent implantation with the same type of tumor cells. In the case of gamma radiation the percentage of successful inoculations fell from 88 to 75, but the number of animals employed is probably too small to warrant any definite deductions regarding any difference in the production of immunity between the beta and gamma rays.

Apparently the degree of immunization caused by progressive absorption of tumors after the use of small doses of beta radiation from radon is more marked than that following the use of larger doses.

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# THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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*Information of interest to all readers will be found on page ii.*

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# EDITORIALS

## THE FIRST DECADE OF AMERICAN ROENTGENOLOGY

BY P. M. HICKEY, M.D.

ANN ARBOR, MICHIGAN

ANYONE who attempts to write a narrative of contemporary events is assisted by the ease with which first hand information can be acquired, but he also labors under the disadvantage of the lack of a proper perspective which comes only after the lapse of years.

Of the three decades in American roentgenology, the first is perhaps the most interesting, especially from a historical standpoint. It will be our pleasant task to enumerate some of the achievements of the first decade and to leave to other pens the history subsequent to 1906.

The writer well remembers the feeling of incredulity which attended the reading of the cabled dispatch announcing Professor Roentgen's discovery, the laconic wording of which has come to mean so much to scientific research. No more striking example can be found of the tremendous importance of fostering pure research, the practical value of which may not be apparent at the time it is being carried on, but which may later develop into results of great moment for the human race.

Roentgen himself did not realize the far-reaching effect of his announcement of a new law in physics. In his original monograph which appeared in December, 1895, he alludes only briefly to the possibility of the new force being of benefit to surgery.

The governing bodies of our great manufacturing, educational, and governmental institutions should consider well this striking example of the value of furthering research even if the practical aspect is not apparent at the time the studies are being made.

The year following Roentgen's publication, scientific workers pursued with feverish activity their research and experiments along the new line of thought. When we work in our present well-equipped laboratories, it is hard to realize, but nevertheless most instructive to recall, the difficulties which beset the pioneers of Europe and America. The *x*-ray tubes could support only a feeble amount of current, the *x*-ray coils were of limited capacity and most troublesome to operate. Oftentimes the source of current was limited to electrical energy produced by a few wet batteries, as the commercial street current was still in its developmental period. However, with a problem on which was focused the brilliant minds of the world, the mechanical and technical difficulties were solved one by one, the tubes and coils were rapidly improved with a corresponding betterment of the results.

It would be an interesting chapter in the development of American roentgenology to trace the gradual solution of the tube and coil problem, but we feel that the time at our disposal will be better spent if we sketch, even though briefly, the work of the pioneers in American roentgenology. However, in the recital of their brilliant achievements, there is a note of sadness because of their martyrdom. It would seem as if the genii who guarded the special storehouses of radiation resented the invasions of these tireless workers and invoked on them the curse of suffering and a tortured deathbed. Like the explorers of unknown countries who suffer privations and the pangs of hunger and thirst, so our predecessors in American roentgenology frequently and willingly brought upon themselves subsequent sufferings.

While placing upon their heads the laurel crown of achievement, we are inspired to become better men because of the magnificent way in which they met their fate. Without exception their attitude was one of uncomplaining endurance. The world is ever ready to erect monuments

in stone and sculptured bronze for the heroes of martial deeds, but the heroes of roentgenology have their memories perpetuated in the minds of the students of medical history.

In my first consideration of this topic, I was reminded of the early work of Thomas Edison and so I wrote Mr. Edison asking for a brief account of his work. I take pleasure in quoting the reply verbatim.

"Mr. Edison received your letter of September 12, and has requested me to write and give the information you ask of him.

"Mr. Edison was the first to recognize the importance of the cable announcement of Dr. Roentgen's discovery. The same day he started to make the apparatus and had it finished and working on the next day. Three of the metropolitan dailies heard of it, and for three weeks more than twenty newspaper reporters were stationed at the Laboratory, the work going on nights, days and Sundays.

"As you are no doubt aware, Dr. Roentgen's discovery of the *x*-ray arose from his observing the fluorescence of crystals of platinocyanide of barium on a paper and when brought within the influence of emanations proceeding from the excitation of highly exhausted glass tubes with which he was experimenting.

"Very soon after Mr. Edison commenced experimenting on the *x*-ray he realized that a most important and practical adjunct to the apparatus would be a simple and convenient device by means of which visual examination of opaque objects could be made. To this end he devised a tapering light-tight box having a flexible eye-piece at the top and a handle in the centre. The lower and larger end was to be closed with a screen covered with a material which would be fluorescent to the *x*-ray. This device he named the "Fluoroscope," and it soon became widely known.

"The fluorescing material for the screen called forth a great deal of experimenting. Platino-barium-cyanide was not altogether satisfactory, and was very expensive. He discovered that a much cheaper material—tungstate of calcium—was highly fluorescent to the *x*-ray and would give a great efficiency to fluoroscopic screens. This discovery gave a notable impetus to the practical use of the *x*-ray and to an increase in the manufacture of apparatus for its production.

"Soon after the exhibition to the newspapers, Mr. Edison taught others to manufacture apparatus and fluoroscopes, and also the method of chemically preparing the tungstate of calcium crystals. The *x*-ray was later exhibited by him to the public in 1896 at the Electrical Exhibition, held under the auspices of the National Electric Light Association at the Grand Central Palace in New York. This exhibit created a great public interest.

"At the time Mr. Edison selected tungstate of calcium because it was so fluorescent, he set four men to work making all kinds of chemical combinations, and thus collected upward of 8000 different crystals of various chemical combinations, thus discovering several hundred different substances which would fluoresce to the *x*-ray.

"About a year after the exhibition, Mr. Edison's assistant, Clarence Dally, commenced to lose his whiskers and his hands became inflamed. Several surgical operations followed, including the amputation of his arm, etc., but he soon died of *x*-ray cancer, being the first known victim of the *x*-ray."

Yours very truly,
Wm. H. Meadowcraft,
Assistant to Mr. Edison.

It was undoubtedly due to Mr. Edison's efforts that the roentgen ray was made familiar to the general public at so early a date. His most important contribution was the fluoroscope. Owing to the tragic fate which befell his assistant, Mr. Dally, Mr. Edison then turned his attention to lines of research which did not entail so much danger for his assistants.

In that inspiring book, "From Immigrant to Inventor" Professor Michael Pupin writes:

"When therefore Professor Roentgen's discovery was first announced I was, it seems, better prepared than anybody else in this country to repeat his experiments and succeeded, therefore, sooner than anybody else on this side of the Atlantic. I obtained the first *x*-ray photograph in America on January 2, 1896, two weeks after the discovery was announced in Germany. Newspaper reporters and physicians heard of it and I had to lock myself up in my laboratory in order to protect myself from continuous interruptions.

"Physicians brought all kinds of cripples for the purpose of having their bones photographed or examined by means of the fluorescent screen. The late Dr. Bull of New York sent me a patient, a Mr. Prescott Hall Butler, with nearly a hundred small shot in his left hand. He was in agony and begged me to make an *x*-ray photograph of his left hand and thus enable Dr. Bull to locate the numerous shot. The first attempts were unsuccessful

because the patient was too weak and too nervous to stand a photographic exposure of nearly an hour. My good friend, Thomas Edison, had sent me several most excellent fluorescent screens and by their fluorescence I could see the numerous small shot and so could my patient. I decided to try a combination of Edison's fluorescent screen and the photographic plate. The fluorescent screen was placed on the photographic plate and the patient's hand was placed on the screen. The *x*-rays acted upon the screen first and by its fluorescent light acted upon the plate. The combination proved to be better than I had expected. A beautiful photograph was obtained with an exposure of a few seconds.

"The photographic rays showed the numerous shot as though they had been drawn with pen and ink and Dr. Bull operated and extracted every one of them. Prescott Hall Butler was well again. This was the first X-ray picture obtained by that process during the first part of February 1896 and it was also the first surgical operation performed in America under the guidance of an *x*-ray picture."

To Professor Pupin, therefore, belongs the credit of the application of the intensifying screen for shortening the period of exposure. This discovery of the use of the intensifying screen was described by Professor Pupin in *Electricity* for February 12, 1896.

Another important contribution by Professor Pupin was made when in April 6, 1896, in a communication to the New York Academy of Sciences he sums up as follows: "Every substance, when subjected to the action of *x*-rays becomes a radiator of these rays."

It is very evident that medicine owes a great debt to these physicists since the early work of Thomas Edison and Professor Pupin with the fluorescent screen of tungstate of calcium gave the art of roentgen diagnosis a most noteworthy impetus.

It is also to be noted in this connection that the use of the intensifying screen did not come into general use until many years later. This probably was due to the defects of the early screens and the imperfect methods of coating the crystals of tungstate of calcium on the cardboard background.

In surveying the early field of American roentgenology, one is quite at a loss to know just where to begin. However, the work of Francis Williams of Boston is so conspicuous that we may well mention his work among the first. One factor which prompts us to emphasize his pioneer research is the fact that he wrote so precisely and emphatically concerning the value of the roentgen ray in medicine and surgery, that he is to be regarded as one of the most important pioneers in the development of the clinical side of roentgenology. No student of roentgenology should fail to read carefully Williams' book and to realize that most of the work contained in that book was done during the first five years after Roentgen's discovery.

Williams' first exposition of the value of the roentgen ray in medicine was received with incredulity, nay even with ridicule. However, he has lived to see the sarcasm of his early auditors turned into deserved words of praise, and the prophetic words written at that early date have been verified even beyond his most sanguine expectations. It is noteworthy also that his early realization of the dangers of fluoroscopy and of the necessity for conducting it under stringent precautions preserved the integrity of his hands, so that unlike many of the other early workers, he never suffered any serious harm.

Credit has never been awarded to Williams for his early gastrointestinal work although he was probably one of the first, if not the first, to use a bismuth meal in the human being. The work of Cannon in his student days upon the physiology of digestion in animals is a factor in the early history of American roentgenology to which we can point with pride. His early contributions to the physiology of digestion have been of very far-reaching influence.

I am indebted to Dr. Hugh Cabot for the following ancedote. In opening the discussion on a paper by Francis H. Williams of Boston, before the Boston Medical Library in 1899, Dr. F. C. Shattuck, professor of clinical medicine spoke more or less as follows:

"I have been much interested in the development of *x*-ray and have seen something of its uses as demonstrated by Mr. Walter Dodd at the Massachusetts Hospital. I will admit

that I can see broken bones; that I can see metallic foreign bodies in the extremities, but when it comes to *x*-rays of the chest and to some extent of the abdomen, I am much less clear. Frank Williams has just shown you some plates and tells you that the heart is here and that the lung is here. Now I can't see a thing in these plates and to be truthful, I don't think he can."

In reviewing some of the publications of the first decade of roentgenology in America, we would like to call attention to a most interesting volume entitled, "Notes on X-Light," by William Rollins published in Boston in 1904. The preface reads as follows:

"In these notes are recorded some impressions derived from experiments made after the day's work as a recreation, yet with the hope of learning to design and construct apparatus for my friend, Dr. F. H. Williams, who has done most to show the importance of *x*-light in medical diagnosis."

In this work we find a quotation from the *International Dental Journal* for August, 1896, on the use of celluloid films within the mouth instead of glass plates outside, in *x*-light photography, and a method of employing celluloid films in the mouth by covering them with water-proof paper or thin rubber; also an interesting quotation from the *Electrical Review* of December 15, 1897, "moving the target in a vacuum tube with a magnet to vary the distance from the cathode." This book is most interesting reading to one who is interested in the history of the development of the tools of roentgenology.

In the *Electrical Review* for February, 1899, there is a description by Rollins of the "Seehear," an apparatus for hearing the sounds made by the heart and lungs when the organs are being examined by *x*-light.

In the *Electrical Review* for March 29, 1902, Rollins describes the making of an interchangeable secondary, variable potential, open circuit transformer. He also describes the machine which he devised for winding the sections of the secondary and the method of tying the sections together. His work had a stimulating effect on the development of roentgen tubes and of roentgen apparatus.

In reviewing the work of the pioneers in American roentgenology, one is startled by the fact that so many of these pioneers became martyrs to the force which they were trying to render useful to mankind, but whose hidden and dangerous properties they had not yet learned to protect themselves from. One of the most lovable and interesting characters in this list of American martyrs is Walter James Dodd, whose biography has been so lovingly and so worthily written by John Macy.

Dodd was born in London in 1869, and at the age of ten years came to America. His early education was very inadequate. He was employed for quite a time as janitor in the Boylston Chemical Laboratory at Harvard. While thus employed he attended regularly the lectures given in general chemistry and also the course in qualitative analysis. Later he was made assistant apothecary in the Massachusetts General Hospital, where he continued his study of chemistry and became a registered pharmacist. In addition to his work in pharmacy he was the official photographer of the Hospital. Naturally after Roentgen's announcement, he became interested in *x*-ray work but not until March, 1896, when he was able to procure a commercial *x*-ray tube energized by a static machine, did his plates, which before had not shown the faintest shadows, begin to be of clinical importance. It is related that Dodd and his assistant after their duties in the pharmacy were done for the day would work far into the night. His next acquisition was a 12-inch induction coil acquired during the month that the Massachusetts General Hospital celebrated the Fiftieth Anniversary of ether as an anesthetic. It is related that Dodd's first *x*-ray plates were among the exhibits shown at this anniversary.

In November, 1896, only one month after the installation of the new induction coil, he was treated for a severe dermatitis resembling an acute sunburn and by the following April his burns had so far increased that he was put on the dangerous list at the Hospital. It was as though his hands and face had been scalded, and the pain, on the authority of Dr. Porter, was beyond description. It is related that often

when pain made sleep impossible, Dodd would walk the floor of the pharmacy all night with his hands above his head. From the fact that his injuries came on so early, Dodd will always be remembered as one of the first to suffer from the baleful influence of the roentgen ray.

In July, 1897, Dr. Porter performed the first of his series of operations in skin grafting which were successful and brought relief from pain, and it is noteworthy that Dodd himself was the one who suggested the experiment of skin grafting. Altogether he underwent some fifty operations under ether anesthesia. Although he occupied a unique position in receiving the respect which the medical staff accorded him on account of his tremendous help in roentgen diagnosis, he felt the need of a medical degree and he graduated from the University of Vermont in 1908.

In September, 1909, Walter Dodd was appointed instructor in the use of the roentgen ray in the Harvard Medical school and later his title was changed to "Instructor in Roentgenology." In the "American Practice of Surgery," there appears in Volume 1 the title of, "The Technique of Radiographic Work as Applied to Surgery and the Interpretation of Radiographs," by W. J. Dodd and Dr. Robert G. Osgood.

While Dodd's contributions to the written literature were not numerous, he will be remembered for the striking example of painstaking diagnosis which he furnished to his colleagues. The splendid work which he did at the Massachusetts General Hospital has always been an inspiration to workers in other institutions. His death was undoubtedly hastened by his devotion to his country, going to France in 1915 as roentgenologist with the First Harvard Medical Unit. His friends and professional advisors sought to deter him, but he felt that it was his duty to go and so he pushed aside all objections. It is pathetic to recall that just before leaving, he underwent a severe operation and that he was conveyed from his home to the train in an ambulance. His work in France was of the same high quality as had characterized his previous hospital service and he was soon recognized as a consultant in the area in which he was located. In addition to his high professional attainments, Walter Dodd was loved by all those who came in contact with him, and his cheery smile even in the midst of his suffering was always an inspiration to those who had the good fortune to be numbered among his friends.

Prominent among the pioneers in American roentgenology was Dr. Charles Lester Leonard, who was the first in America and possibly the first in the world to demonstrate a renal calculus by means of the roentgen ray. After a liberal education in the arts, he studied medicine at the University of Pennsylvania and graduated from that institution in 1889. Dr. Leonard became deeply interested in the *x*-ray immediately upon its announcement and devoted himself most assiduously to its study. He generously gave to the world the benefit of these studies. During his life he published some forty-four articles on the application of the roentgen ray; twenty-eight of these were written during the first decade and dealt principally with the practical uses of the *x*-ray in the detection of urinary calculi. We will quote a few titles of some of these early articles. The first article was published in the *American Journal of the Medical Sciences* in August, 1896, with the title, "Cases Illustrative of the Practical Application of the Roentgen Rays in Surgery" (in collaboration with White and Goodspeed). His second article was, "The Value of the Roentgen Ray as a Means of Surgical Diagnosis." This was published in the *University Medical Magazine* for April, 1898. The third article was, "The X-Ray Burn, Its Production and Prevention," "Has the X-Ray any Therapeutic Property?" This was published in the *New York Medical Journal* for July 2, 1898. His first article on kidney stone was entitled, "Renal Calculi" published in the *Annals of Surgery* for August, 1898. This was followed by a number of articles on the same subject during the next few years.

Dr. Leonard was also interested in the treatment of malignancy, and in 1903 in the *Philadelphia Medical Journal* he published an article on the "The Roentgen Treatment of Malignancy," and in

*American Medicine* in 1904, an article entitled, "The Roentgen Treatment of Malignant Diseases of the Breast." As a writer he was successful in presenting his conclusions in a pleasing and convincing manner. When we consider that his work was done for many years with a very small coil and without any of the elaborate devices which surround every modern roentgen-ray worker, we appreciate better the painstaking technique which procured dependable results in spite of the difficulties under which the examinations were made. The writer well remembers seeing his laboratory which was very simply furnished, containing a small mohair-covered couch with a few pillows. In the room was a small induction coil but it was used by a master of the art. He steadfastly realized that in order to procure soft tissue detail with the maximum amount of contrast, it was necessary to use a soft tube and as the limitations of his coil precluded a high milliamperage, it was necessary for him to make rather long exposures. However, he used a painstaking technique posing the patient very carefully and with his pillows he arranged the position of the patient so that the curve of the back would be flattened and the kidneys brought as near as possible to the roentgen plate. For this special work he had a special plate made sufficiently long to cover the entire genito-urinary tract. The accuracy of his diagnostic conclusions was remarkable. In addition to the qualities which made him a leader in his specialty, he had a very kindly disposition and was always ready to share his knowledge with his colleagues, especially with the younger men.

On first hearing of Dr. Leonard's wonderful work in the detection of calculi, the writer wrote to him asking for some of the points of his technique and received in reply a letter which was treasured for many years. This covered some four large pages written in longhand describing the technique which he happened to be using at that time. This consisted in placing a shallow drawer under his patient, the drawer containing four or five plates superimposed and making multiple exposures withdrawing one plate after the other so that one of them would be found to have the proper exposure. He was also fond of placing two x-ray plates with the emulsion surfaces together in a light tight envelope and after these were exposed and finished, they would be bound together, securing in this way the same intensified effect which we now obtain with our double coated films.

As the result of Dr. Leonard's work with the open tube in the early days and his applications to the fluoroscope, he developed a chronic dermatitis for which he always refused surgical relief. These lesions became worse and like many other of the martyrs of this specialty he suffered most severely. Throughout all his suffering, however, his fortitude was quite remarkable and he bore the severe pains with great courage. After a lapse of some years, we can, in reviewing his work, begin to realize the debt which the medical profession owes to Dr. Leonard and especially the great obligations of the genito-urinary surgeons for his pioneer work. Dr. Leonard's professional attainments were well recognized in this country and also abroad. At the time of his death Dr. Leonard had just finished the compilation of a very comprehensive and elaborate report on the status of the roentgen ray in gastro-intestional conditions. This report was written for presentation at the Section on Radiology of the International Congress in Medicine in London in 1913. In 1906 he organized the Philadelphia Roentgen Ray Society and was its secretary up until the time of his death.

One of the strikingly interesting workers in America in the early days of roentgenology was Mihran H. Kassabian. For years he was Director of the Roentgen-Ray Laboratory of the Philadelphia Hospital but also found time to devote to the study of electrotherapeutics. In 1907 he published the volume entitled, "Electrotherapeutics and Roentgen Rays," a well-illustrated volume of some 526 pages. A strikingly pathetic feature of the book is the fact that the author publishes in this volume photographs of his own hands showing the appearance of chronic roentgen-ray dermatitis, with the legend stating that the lesions began in 1899, while the photographs were taken in 1905. The

lesions which he portrayed in his own book became worse and finally after severe suffering he succumbed to the insidious influence of the radiant energy, the study of which had been his life-long occupation.

Kassabian's book is valuable from the fact that it is, first of all, a marvelously complete account of the early work of roentgen-ray workers in the Old World and in America; and second, because it gives in a modest way his personal experiences and achievements with the roentgen ray in diagnosis and therapy. The field which he covered was very wide and many of the conclusions written twenty-five years ago show evidence of the thorough study which makes them authentic even today. This work of Kassabian's was most valuable because it gave to the younger workers in roentgenology an account of what already has been done and was probably the best work on technique at that time.

The earlier book of Williams' and this latter work of Kassabian's did much to develop American roentgenology. These two writers deserve the greatest credit for filling the gap which otherwise would have been so conspicuous in American roentgen-ray literature. Kassabian was one of the early advocates of stereoscopy and he devotes considerable space to this topic in his book. He devised a special head rest for examination of the nasal sinuses and also a special table for roentgenographing the heart and lungs both in the prone and vertical positions. He devised also the punctograph for the exact location of foreign bodies in the extremities.

Like his coworkers, Kassabian was remarkable for his constant devotion to his chosen studies and for an untiring quest of knowledge. He was of a very quiet disposition, his attitude at times being almost somber, but an occasional remark would show that he was not devoid of a keen sense of humor. His book will always be a valuable reference volume for the student interested in the history of the development of roentgenology in America.

One of the most prolific writers during the first decade was Carl Beck. The list of his articles which he had published up to 1904 was seventy-six, some of which appeared in German publications. In 1904 his book on "Roentgen Ray Diagnosis and Therapy" was brought out by Aberman and Company. This book presents many interesting features, one of which was his use of the tubular diaphragm of which he was a great advocate, and a curious device which he called "the osteoscope," designed as a substitute for the operator's hand as an index of penetration. It consisted of the dried bones of the human hand and wrist attached to a cardboard screen and held by the operator's hand which was protected by a metal shield. This allowed the author to watch the condition of the vacuum of his tube during the time of exposure without injurious exposure of his own hand. Carl Beck did considerable work on the detection of biliary calculi and he was evidently one of the very earliest American writers on this subject. He devotes a considerable portion of his book to therapy, a part which is profusely illustrated.

H. Clyde Snook began his *x*-ray work as an assistant of Professor Goodspeed, professor of physics at the University of Pennsylvania. In 1904 he brought out the Jumbo coil which at that time was a very efficient and practical apparatus for generating a high tension current. Previous to 1904 there was no convenient means of estimating the amount of current which was going through the tube. At the meeting in 1904 of the American Roentgen Ray Society, Mr. Snook demonstrated the *x*-ray milliammeter, the value of which was apparent to those who had worked with the old method of guessing at the exposure from the appearance of the tube.

Later Snook brought out the interrupterless transformer freeing us from the tiresome care of the various types of interrupters, a relief for which we all have been very grateful.

The work of Professor Goodspeed, like some of the other physicists, began very early in the decade under discussion. It is probable that he made the first diagnostic plate in this country showing a fracture of bone. One of the early notable cases was locating a jack stone in a child's esophagus. Dr. Goodspeed and Dr. Harry Tetrell published a paper in which Dr. Goodspeed suggested the word "radiograph," and

Dr. Tetrell suggested the word "skiagram" in place of the then employed term "*x*-ray picture." It is most interesting to note that Dr. Goodspeed still has in his possession a photographic slide showing coins which had been placed upon the outside of a photographic plate holder and then exposed, as he thought, to the cathode ray. This was in the Winter of 1890, and while this was five years before Roentgen's monograph, Dr. Goodspeed never laid any claim to the discovery of the *x*-ray.

An early pupil of Dr. Leonard's was one who has rivalled him in the number of contributions to roentgen-ray literature. Dr. George E. Pfahler began his work in 1899 in association with Dr. Leonard of the Philadelphia General Hospital. From 1900 to 1902 he was in charge of an *x*-ray laboratory at the Philadelphia General Hospital and in the Fall of 1902 he was made director of the *X*-ray Laboratory of the Medico-Chirurgical Hospital. In 1903 he began to give clinical instruction in connection with Prof. J. M. Andres' clinic and in connection with the surgical clinic.

During the first decade of American roentgenology Dr. Pfahler contributed and published some twenty-two articles, of which I will quote the titles of a few: "The Treatment of Cutaneous Cancer by the *X*-ray," published in September, 1901; "Tumors of the Brain Localized Clinically and by the Roentgen Ray with some Observations relating to the Use of the Roentgen Ray in the Diagnosis of Lesions of the Brain," *Philadelphia Medical Journal*, February, 1902; "An Additional Case of Tumor of the Brain Localized Clinically and by the Roentgen Ray," *Philadelphia Medical Journal*, September, 1902; "Tortuosity of the Aorta," *American Journal of Medical Sciences*, October, 1903; "Cerebral Skiagraphy," *American Journal of Medical Sciences*, December, 1904; "Report of a Case of Sub-Phrenic Abscess," September, 1904; "The Diagnosis of the Size, Form, Position, Motility of the Stomach and Bowel by Means of the *X*-ray," *Archives of Physiological Therapy*, July, 1905. "The *X*-ray in the Diagnosis of Pulmonary Tuberculosis," *Archives of Physiological Therapy*, September, 1905. "A Roentgen Ray Filter and a Universal Diaphragm and Protecting Screen," *Archives of Physiological Therapy*, November, 1905.

Dr. Pfahler was remarkable in his early work and also in his later work for his ability to divide his investigations between diagnosis and therapy. His contribution to each of these two divisions has been most important. The most important improvement in therapy, namely, the use of the filter, was introduced by him. This somewhat short mention of Dr. Pfahler's work should not be regarded as an evaluation of his place in American roentgenology, but simply an account of what he did prior to the year 1905.*

## ALBERT M. COLE, M.D.

American roentgenology has suffered a severe loss in the death of Dr. Albert M. Cole of Indianapolis. During the last four years Dr. Cole had been in poor health, with a gradual increase in his symptoms which during the last few months had prevented his active participation in his professional work.

Dr. Cole was born in Charlestown in 1870 and graduated from the literary department of Depauw University and later from the medical department of Indiana University in 1894. He continued his medical studies at the University of Pennsylvania and graduated there in 1896.

He became interested in roentgenology in 1901. For many years he was Professor of Roentgenology and Dermatology at the Indiana University School of Medicine. For many years he served as roentgenologist to the various hospitals of Indianapolis.

His immediate family who mourn his loss are his widow, Mrs. Ruth Schuyler Cole and two sons, Albert Maynard Cole and Henry Schuyler Cole.

Dr. Cole was a pioneer in the field of American roentgenology. For years he was a familiar figure in the sessions of the American Roentgen Ray Society, and many other medical organizations of which he was for many years an active member. His tall commanding figure and his modest

* To be continued in the September issue of the Journal.

method of presentation of his professional papers will long be remembered by those who had the fortune to be associated with him.

It is interesting to note the dominant personalities in the development of American roentgenology when we view it from a geographical standpoint. Certainly anyone in thinking of the development of radiology in Indiana would immediately think of the name of Dr. Albert Cole. His high professional ideals made the influence of his strong personality a powerful factor in the growth of roentgenology in the State in which he lived. He was interested in the diagnostic as well as in the therapeutic side of the application of the roentgen ray, and in the pursuit of his profession he accomplished much good.

In looking back over Dr. Cole's work and the position which he attained, one feels that he is entitled to the greatest praise that can be accorded to a man; namely, that he contributed his share to the betterment of mankind.

P. M. Hickey.

## CHISHOLM WILLIAMS F.R.C.S. ED.

We quote the following from the *British Medical Journal* for April 21, 1928, page 694:

"We regret to announce the death, which took place suddenly at Finchley on April 10th, of Mr. Chisholm Williams, one of the earliest in this country to foresee and develop the medical uses of *x*-rays, and one who, like many of those pioneers, suffered gravely from the effects of handling this then dangerous medium. George Chisholm Waldemar Williams began his professional career as a student at St. Thomas's Hospital, and obtained the diplomas L.S.A. in 1891 and M.R.C.S., L.R.C.P. in 1892. In 1898 he obtained the F.R.C.S. Ed. From his earliest days as a practitioner he was keenly interested in the application of electricity to medical practice, and devoted his spare time to experimental work. In 1895, seven weeks after Professor Roentgen had announced the discovery of the rays which were named after him at the time, Chisholm Williams succeeded in repeating the original experiments, and in making an *x*-ray photograph of his own fingers. Thereafter his devotion to the development of this discovery was unbroken, and he gave particular attention to the employment of the rays in the treatment of tuberculosis and cancer with a considerable degree of success. He was appointed surgeon to the City Orthopaedic Hospital, London, in 1894, and gave his services to that institution for some fourteen years. From 1903 to 1908 he was in charge of the *x*-ray department of the West London Hospital, and lecturer in radiology to the West London Post-Graduate College. In 1906 he joined the staff of St. John's Hospital for Skin Diseases.

"From 1916 to 1919 he served with the R.A.M.C. in the rank of captain as electrotherapeutist to the Eastern Command Depot. It was at this period that the evil effects of the years of exposure to *x* rays, at a time when neither the need for nor the means of protection were known, became fully apparent. The condition of his hands had been severely aggravated by contact with septic cases during his war service, and a prolonged series of operations became necessary; after years of suffering the whole of one hand and two fingers of the other were amputated. As a result he was forced gradually to relinquish all active work. It was only last year that his services to science and his sufferings in its cause obtained recognition. In June, 1927, he received from the hands of the Duke of Connaught, at the prize-giving ceremony in connexion with the St. Thomas's Hospital Medical School, the bronze medallion of the Carnegie Hero Fund, the highest award of that body, given "for heroic endeavour to save human life," together with a cheque for the first instalment of a pension awarded him by the Fund. A few weeks later he was granted a Civil List pension in recognition of his self-sacrificing and devoted services in the application of *x*-rays to the diagnosis and treatment of disease."

# SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

*Items for this column solicited promptly after the events to which they refer.*

## MEETINGS OF ROENTGEN SOCIETIES*

### United States of America

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. John T. Murphy, 421 Michigan Ave., Toledo, Ohio.
Twenty-ninth annual meeting, Hotel President, Kansas City, Mo., Sept. 25–28, 1928.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.
Annual meeting, Portland, Oregon, 1929.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. Fred M. Hodges, 801 West Grace St., Richmond, Va.
Annual meeting, Portland, Oregon, 1929.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. Robert J. May, St. Luke's Hospital, Cleveland, Ohio.
Fourteenth annual session, Chicago, Ill., Dec. 3–7, 1928.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.
Next annual meeting, Asheville, N. C., Nov. 12–15, 1928.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. W. T. Bronson, Englewood Hospital.
Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. James H. West, 8314 Euclid Ave.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. O. J. Shore, 2033 Park Ave.
Meets monthly on second Friday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. Carl S. Oakman, Muncie, Indiana.
Annual meeting each February 22 in Indianapolis. Next meeting in Indianapolis, February, 1929.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. John D. Camp, Massachusetts General Hospital, Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. E. Everett Rowell, 200 West 59th St.
Meets monthly on third Monday, New York Academy of Medicine.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

ROENTGEN RAY SOCIETY OF CENTRAL PENNSYLVANIA
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. Eugene Pendergrass, University of Pennsylvania, Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. James M. Flynn, 282 Alexander St.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Metropolitan Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.
Annual meeting, Galveston, Texas, 1928.

VIRGINIA ROENTGEN RAY CLUB
Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.
Annual meeting Oct. 17, 1928.

### British Empire

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Director, Dr. John Muir, 32 Welbeck St., London, W. 1.
Meets on the third Thursday of each month, from November to June inclusive, at 8.15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winter at 8. 30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

RADIOLOGICAL SECTION, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. C. A. Anderson, The Hospital, Dunedin.

* Secretaries of societies not here listed are requested to send the necessary information to the editor.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.
Next annual meeting, Charlottetown, P. E. I., June 21–23, 1928.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.
Meets annually.

CONTINENTAL EUROPE

BELGIAN SOCIETY OF ROENTGENOLOGY
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIETE DE RADIOLOGIE MÉDICALE DE FRANCE
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIETE FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE
Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHO-SLOVAKIA
Secretary, Dr. Walter Altschul, German University, Prague, II/52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RÖNTGENKUNDE UND STRAHLENFORSCHUNG)
Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.
Next meeting with the Gesellschaft deutscher Naturforscher und Aerzte will be in Hamburg, Sept. 16–21, 1928.

SUD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA
Secretary, Professor M. Ponzio, University of Turin, Turin.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs S. A. Reinberg and S. G. Simonson.
Meets annually.
Sixth Annual Meeting, 1929, to be announced.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw.
Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Secretary, Dr. H. Scheuermann, Copenhagen
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY
Secretary, Professor Holzknecht, Vienna, IX, General Hospital.
Meets on the first Tuesday of each month from October to July.

# AMERICAN ROENTGEN RAY SOCIETY

## PRELIMINARY PROGRAM

### ANNOUNCEMENTS

All members and friends of the American Roentgen Ray Society are cordially invited to attend the 29th Annual Meeting of the Society at Kansas City, Missouri, from September 25 to 28, 1928, inclusive. Headquarters at the President Hotel, Fourteenth and Baltimore Avenue.

The top Assembly Floor of the President Hotel affords excellent space for the Scientific Sessions in the Junior Assembly Hall. Registration will be in the foyer of this Assembly Floor. The Scientific Exhibit and the Commercial Exhibit will have splendid accommodation in the huge Congress Room upon this same Assembly Floor.

The Scientific Exhibit already has illuminated space for nearly 1,000 8 × 10 negatives or reproductions.

The Commercial Exhibit will be most accessible and upon the same floor with all other activities.

The Ladies' Entertainment Committee has arranged social activities for each day and evening that is available. Ladies' Information Desk upon mezzanine floor of President Hotel.

The Golf Committee has made arrangements with two of the best courses for play at times convenient to those who enjoy this recreation. They have many prizes for the fortunate.

### EVENING EVENTS

*Tuesday Evening* the Informal Lantern Slide Exhibits will be shown and all members and guests are invited to bring difficult and interesting case reports and slides. Several motion reels have been promised. Motion pictures from the International Radiological Congress at Stockholm will be shown.

Following the Lantern Slide Exhibit upon Tuesday evening there will be a smoker at the University Club.

*Wednesday Evening* Dr. Preston M. Hickey, Professor of Roentgenology at the University of Michigan, Ann Arbor, Mich., will deliver the annual Caldwell Lecture in the Assembly Hall. All members, guests and ladies invited.

Wednesday evening, following the Caldwell Lecture, there will be a reunion at the Kansas City Club, of the medical officers who attended the Kansas City School of Military Roentgenology in 1917.

*Thursday Evening* the annual banquet will be held at seven o'clock in the Junior Assembly Hall. All members, ladies, guests and exhibitors invited to attend. Purchase tickets when you register.

### SCIENTIFIC PROGRAM

(Position upon program reserved for final announcement)

In addition to the program material listed below, it is proposed to have reports from the five sections of the International Radiological Congress at Stockholm, July 23–28, 1928, by competent observers chosen from the membership of the society.

#### DISEASES OF OSSEOUS SYSTEM

(1) "Congenital Bone Syphilis; Preliminary Report; Roentgenologic Study with Notes on the Histology and Pathology."
Dr. Eugene P. Pendergrass and Dr. Ralph S. Bromer, Philadelphia, Pa.

(2) "Epiphysitis, with special reference to Etiology."
Dr. Lester A. Smith, Indianapolis, Ind.

(3) "Clinical and Roentgen Study of Multiple Benign Sarcoid of Boeck with Bone Lesions."
Dr. Howard P. Doub and Dr. Frank R. Menagh, Detroit, Mich.

(4) "The Roentgenologic Aspect of Endothelial Myeloma."
Dr. B. R. Kirklin and Dr. H. M. Weber, Rochester, Minn.

(5) "Paget's Disease of the Osseous System with Report of Fifty-six Cases."
Dr. L. T. LeWald, New York City, N. Y.

#### ACCESSORY SINUS SYMPOSIUM

(6) "Interpretation of Sinus Roentgenograms."
Dr. G. W. Grier, Pittsburgh, Pa.

(7) "Sinus Radiography."
Dr. Ernest C. Samuel and Dr. E. R. Bowie, New Orleans, La.

(8) "Stereoscopic Interpretation of Ethmoid and Sphenoid Sinuses."
Dr. A. P. Overgaard, Omaha, Nebr.

(9) "Accessory Nasal Sinuses."
Dr. H. M. Imboden, New York City, N. Y.

(10) "*X*-ray studies of the Mastoid in Infants."
Dr. Charles L. Martin, Dallas, Texas.

(11) "Metallic Conjunctival Markers: An Aid in the Localization of Intra-ocular Foreign Bodies."
Dr. J. M. Patton, Omaha, Nebr.

#### DISEASES OF THE PULMONARY SYSTEM

(12) "The Results of Surgical Treatment of Pulmonary Lesions, with Special Reference to Phrenectomy and Thoracoplasty."
Dr. W. A. Evans, Detroit, Mich.

(13) "Recurrent Massive Collapse of the Lung due to a Benign Tumor of the Bronchus."
Dr. H. E. Ashbury, Baltimore, Md.

(14) "Pneumothorax."
Dr. E. L. Jenkinson, Chicago, Ill.

(15) "Bronchiectasis: What the Use of Iodized Oil Has Demonstrated Relative to the Diagnosis by the Ordinary Roentgen Examination."
Dr. A. Hartung, Chicago, Ill.

(16) "A Further Study of the Advisability of a General *X*-ray Chest Survey Applied to Recruits of the United States Army."
Dr. Charles L. Maxwell, Washington, D. C.

(17) "A Lantern Demonstration of Basal Types of Tuberculosis."
Dr. Kennon Dunham, Cincinnati, Ohio.

(18) "Lobar and Central Pneumonias in Children."
Dr. F. B. Stephenson, Denver, Colo.

(19) "Routine Roentgen Chest Examinations."
Dr. Ralph A. Kinsella, St. Louis, Mo.

(20) "Pulmonary Syphilis."
Dr. R. G. Allison, Minneapolis, Minn.

#### DISEASES OF THE GASTRO-ENTEROLOGIC SYSTEM

(21) "The Role of the Roentgen Ray in Determining the Operability of Gastric Carcinoma."
Dr. A. B. Moore, Rochester, Minn.

(22) "Diverticula of the Colon."
Dr. James T. Case, Battle Creek, Mich.
(23) "Diapedetic Hemorrhage from the Gastro-Intestinal Tract."
Dr. L. R. Sante, St. Louis, Mo.
(24) "The Significance of Calcified Abdominal Lymph Nodes."
Dr. Ross Golden, New York City, N. Y.
(25) "A General Resume of the *X*-ray Diagnosis of Gall Bladder Disease, starting from the First Efforts to Demonstrate Calculi up to the Present Cholecystography."
Dr. Webster W. Belden, New York City, N. Y.
(26) "Cholecystography, Oral Administration in 100 Consecutive Cases Checked Against Surgical Findings."
Dr. C. J. Johannesson, Walla Walla, Wash.
(27) "Duodenal Peristalsis."
Dr. Lester Levyn, Buffalo, N. Y.
(28) "Radiologic Findings in Extrinsic Gastro-Intestinal Lesions."
Dr. D. Y. Keith, Louisville, Ky.
(29) "The Upper Left Quadrant."
Dr. E. C. Koenig, Buffalo, N. Y.

THYMIC GLAND SYMPOSIUM

(30) "The Treatment of Thymus Gland in Infants and Children."
Dr. R. G. Taylor and Dr. Mila J. Kinney, Los Angeles, Calif.
(31) "*X*-ray Diagnosis and Treatment of Enlarged Symptomless Thymus in Children."
Dr. Frederick W. O'Brien, Boston, Mass.
(32) "Study of the Thymus from the *X*-ray Standpoint."
Dr. C. Winfield Perkins, New York City, N. Y.

THE THERAPY OF MALIGNANCY

(33) "Treatment of Carcinoma of the Breast, Studied in the Light of the Saturation Method of Treatment."
Dr. G. E. Pfahler, Philadelphia, Pa.
(34) "Malignant Diseases of the Lip and Mouth."
Dr. Douglas Quick, New York City, N. Y.
(35) "Dosage Measurements."
Dr. U. V. Portmann, Cleveland, Ohio.
(36) "A Plea for the Use of Both Radium and High Voltage *X*-ray in the Treatment of Practically Every Case of Carcinoma of the Cervix."
Dr. W. S. Lawrence, Memphis, Tenn.
(37) Further Studies of the Dosage Problem in Ultra-Violet Light Therapy."
Dr. E. A. Pohle and Dr. Ralph A. Sawyer, Ann Arbor, Mich.
(38) "Saturation Dosage in Superficial Treatment."
Dr. A. K. Owen, Topeka, Kans.
(39) "Observations on the Effect of Lead and Radiation in Cancer."
Dr. Henry J. Ullmann, Santa Barbara, Calif.
(40) "Treatment of Cancer of the Rectum."
Dr. T. A. Jones, Cleveland, Ohio.
(41) "Radiotherapy of Tumor of the Testis."
Dr. A. U. Desjardins, Rochester, Minn.

MISCELLANEOUS SUBJECTS

(42) "The Rôle of Roentgenology in Psychiatry"
Dr. M. J. Hubeny, Chicago, Ill.
(43) "Diagnostic Section of the International Congress."
Dr. W. F. Manges, Philadelphia, Pa.
(44) "The Roentgenologist as a Consultant."
Dr. P. R. Casellas, Chicago, Ill.
(45) "Tumor of the Kidney."
Dr. B. H. Nichols, Cleveland, Ohio.
(46) "Roentgenography of the Uterus and Adnexa with the Use of Lipiodol as a Contrast Medium."
Dr. E. R. Witwer (by invitation), Detroit, Mich.
(47) "A Roentgenographic Consideration of the Tempero-Mandibular Joint (with Technic)."
Dr. Paul A. Bishop, Philadelphia, Pa.
(48) "Industrial Spines."
Drs. William B. Bowman and Lowell S. Goin, Los Angeles, Calif.
(49) "A Roentgenologic Study of Mitral Cardiac Lesions."
Dr. David Steele, Cleveland, Ohio.
(50) Encephalography:
"The Clinical Aspect."
Dr. Temple Fay, Philadelphia, Pa.
"Roentgen Studies."
Dr. H. K. Pancoast, Philadelphia, Pa.

Executive Sessions of the Society will follow the Scientific Sessions of Tuesday and Thursday afternoons.

The Executive Council will hold its first meeting upon Monday afternoon or evening, September 24, at the President Hotel, Mezzanine Floor.

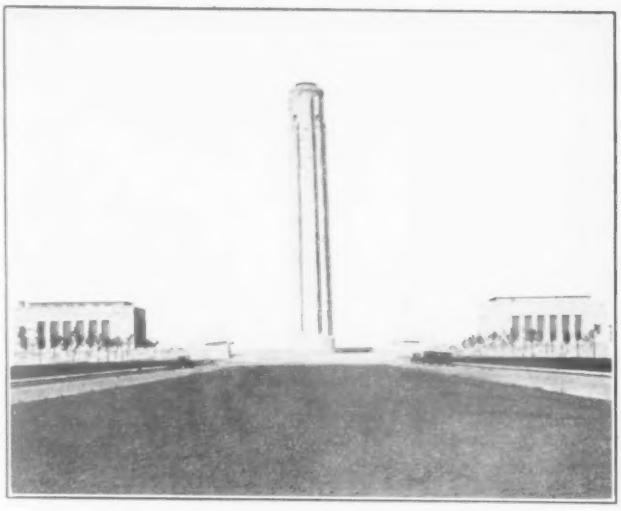
The *final program* will be mailed to members of the American Roentgen Ray Society as early in September as possible. Those who are not members and who desire this final program will kindly address the Program Committee, American Roentgen Ray Society, 1020 Rialto Bldg., Kansas City, Missouri, and it will be mailed to them as soon as printed.

## KANSAS CITY—PAST AND PRESENT

Kansas City in 1850, was a trading post and outlying settlement on the banks of the Missouri. Today, a monument to the vision and driving power of the aggressive American, it stands as the industrial gateway to a region the like of which the world has never seen. This far flung industrial monument is encircled by winding drives of marvelous beauty, dotted with parks which rank among the finest in the nation, and intersected by boulevards lined with beautiful residences. As Kansas City has grown in size, in industrial expansion, in civic affairs, and in the countless other things that make a city, so has its ability to welcome the stranger grown in even greater proportion. Its people are the sons and daughters of pioneers and as such they issue a sincere invitation to the membership of the American Roentgen Ray Society to attend their own convention here in September.

In this connection a few statistics as to Kansas City's growth and development may be of interest.

The population of Greater Kansas City today is 600,000. Its suburban trade population is approximately seven hundred and fifty thousand with twenty million living within the borders of its trade territory. The area within its corporate limits is fifty-seven and three-quarters square miles.



Memorial of Kansas City's heroes.

The Memorial to Kansas City's heroes stands directly across the plaza south of the Union Station. The shaft is 280 feet high and is flanked by a hall of records and a veterans' meeting hall. A fire will burn constantly at the top of the shaft, a burning flame at night and a pillar of smoke by day. There is an elevator to take visitors to the top of the shaft, where a marvelous view of the city and surrounding territory can be obtained. The cost of the Memorial was $2,500,000, this sum being raised in one week by popular subscription.

Shopping facilities are the best in this section and among the best in the nation. Anything desired by the visitor can be bought here at a much lower cost than in other cities where operating expenses and overhead are much higher comparatively.

Street car service is excellent. By a judicious use of time the visitor can see the beautiful parks, business district, city gardens, beautiful homes and points of interest with little expense. The street car company also operates a complete intercity system of busses.

The Union Station is the fourth largest in America and the largest outside of New York City and Chicago. The main building is five hundred and ten feet long and one hundred and fifty feet wide. The grand lobby is 230 × 100 feet with a ninety-foot ceiling. The main waiting room is the longest in the world, four hundred and ten feet, built over thirty-two tracks, with three hundred trains leaving and arriving daily. Passengers by interurban and steam lines to and from Kansas City total more than seven and a half million each year. Thirteen trunk lines of railroad, with thirty-two subsidiary lines, enter Kansas City.

Union Station.

Interurban cars, as well as busses of the latest construction, await the visitor's pleasure in regard to trips to nearby places at a trifling cost. Within an hour's ride is Excelsior Springs, Mo., the "Carlsbad of America," where thousands gather to drink the healthgiving waters. In a trifle longer journey can be seen the University of Kansas, Forth Leavenworth, the U. S. Federal and Kansas

Kansas City.

State prisons, and many similar places of interest. There are seven interurban systems and several interstate bus lines.

Motor trips are made easy by the fact that Kansas City is the central point on three transcontinental U. S. highways, 40, 50 and 71. Two run east and west from coast to coast and one from Canada to the Gulf. There are numerous other highways passing through Kansas City. The State of Missouri is now completing a $50,000,000 hard surfaced highway system. The trails make it easy for the visitor in the motor car to include the wonderful Ozark region in his itinerary.

Financially Kansas City is the leader in the Southwest. It has seventy-one national and state banks, with a total capital, including surplus and undivided profits, of more than thirty-three million dollars. The Federal Reserve Bank, of Kansas City, District No. 10, has a total capital of more than thirteen million dollars at the present time. There are forty-two building and loan associations.

Restaurants in Kansas City are numerous. The truck gardens and farms near Kansas City, together with the packing plants, favorable railroad location and lack of labor troubles, make "good things to eat" in Kansas City command a price anyone can pay.

Theaters in Kansas City are among the latest in size and entertainment. There are thirteen stage theaters and fifty-seven motion picture houses. One motion picture house, recently built, maintains one of the largest orchestras, and has one of the most elaborately constructed theater buildings in the United States.

Newspapers published in Kansas City are nationally famous, with a circulation reaching the entire Southwest. There are more than one hundred other publications, embracing all lines of industrial, civic and social life. All show a keen interest in civic affairs and in the activities of conventions.

Clubs in Kansas City are famous for their construction and facilities. The recently completed Kansas City Club and Kansas City Athletic Club buildings are two of the finest in the Middle West. In addition there are the City Club, a first class Woman's City Club, and a host of others, ranking with the best. All leading national clubs have branch organizations here.

Golf Clubs in Kansas City have an international reputation. There are ten such clubs with several additional in the process of formation and they are unequaled as beauty spots in regard to both buildings and grounds.

Art and music find a logical outlet here. The Kansas City Art Institute is supported by prominent citizens with a deep appreciation of art, and its service and scope are growing at a prodigious rate. A new art exhibition is given every month. Musical institutions rank among the highest. The Western Gallery of Art, in the Public Library, is well worth a visit.

Amusements are diverse and comprehensive. In the summer months the American Association baseball team, the "Blues," plays many home games in the largest minor league plant in the world. Amusement parks, within a twenty-five minute ride of the downtown section, run continuously during the summer.

Drives of national beauty bring delight to the visitor who rides over their smooth surface and sees the far flung panorama of beautiful homes, rivers, parks and industrial sites as it unfolds before and below him. Cliff Drive, with its beautiful borders and wonderful view, is alone well worth a trip to Kansas City. It is three and one-half miles long.

Boulevards running continuously for more than ninety miles are to be found in the "Heart of America." They have been acclaimed by foreign experts in civic planning, as well as by American authorities, to be among the world's finest. The reason is due to the experience gained by its founders through observation of other municipalities, and the adaptability of Kansas City's topography.

Parks of magnificient beauty greet the eye of the visitor to the "Heart of America." Swope Park, with more than thirteen hundred acres, is the third largest in America, and contains acres of flower beds, stone rest houses, camping shelters, zoo, lodges and other buildings. There are lakes, broad stretches of woods, winding walks, and large expanses of

meadow land, on which are the public golf links. In addition, there are thirty other parks scattered throughout the city.

Historical and other points of interest in and around Kansas City are numerous. It was here the famous Battle of Westport Landing, which decided that the West would remain in Union control was fought. Sites and places reminiscent of the Civil War period are numerous. Long a frontier town, much has remained to interest the visitor. The Missouri Valley Historical Association building is open to visitors at all times.

The climate in Kansas City reveals, in unmistakable terms, the reason for the dominant characteristics of its people. The city lies near the middle of the temperate zone. There are no long drawn out winters, and no scorching summers. It gets nearly all of the good weather and little of the bad. Kansas City is from nine hundred to one thousand feet above sea level. The normal temperature for the past thirty-two years for the spring months is: March, 43; April, 55; May, 64. Summer: June, 74; July, 78; August, 77. Autumn: September, 68; October, 58; November, 44. Winter: December, 33; January, 29; February, 30. The average is 55. The following government table illustrates Kansas City's favorable weather.

AVERAGE TEMPERATURE

| City | Period Covered Years | Spring | Summer | Autumn | Winter |
|---|---|---|---|---|---|
| New York | 50 | 49 | 72 | 55 | 32 |
| Cincinnati | 49 | 54 | 75 | 57 | 34 |
| Chicago | 50 | 46 | 70 | 53 | 26 |
| St. Louis | 50 | 56 | 77 | 58 | 34 |
| Minneapolis | 30 | 44 | 70 | 48 | 16 |
| Omaha | 48 | 50 | 74 | 53 | 24 |
| Buffalo | 45 | 43 | 68 | 51 | 26 |
| Milwaukee | 50 | 43 | 68 | 50 | 23 |
| Cleveland | 51 | 46 | 70 | 53 | 28 |
| Philadelphia | 49 | 52 | 74 | 57 | 34 |
| Kansas City | 32 | 54 | 76 | 57 | 31 |

Churches in Kansas City number more than four hundred. They are of all denominations known, with magnificient edifices, many of which are in the downtown section, a few minutes' walk from hall or hotel.

Industrially, Kansas City has grown rapidly. Today it ranks first among American cities in distribution of agricultural implements, kaffir corn, milo maize, lumber and seeds, in farming territory, beautiful residential districts, connected park and boulevard system, as a hay market, live stock exchange, in the manufacture of American black walnut, as a primary winter wheat market, in reciprocal insurance business, stock and feed cattle and stock hogs; second as a horse and mule market, livestock market, meat packing center, in receipt and distribution of fruits and vegetables, and in volume of discount paper; third in distribution of butter, eggs and poultry, in flour milling capacity and production, as a general grain market, and in soap manufacture; fifth in grain elevator capacity; sixth in postoffice receipts; tenth in bank clearings; twelfth in manufacturing pursuits; eighteenth as a population center and nineteenth in population.

Wholesale houses are numerous and can supply from their immense stocks practically every article sold at wholesale, their annual output amounting to more than $700,000,000. Kansas City's location as the gateway to the great West and Southwest territory, and its excellent shipping facilities are mainly responsible for this immense business.

Manufacturing developments have kept pace with the growth of the city. Few people realize how big a manufacturing center it really is. The factories of Greater Kansas City turn out more than $600,000,000 worth of products annually. Articles of every nature are manufactured.

Schools in Kansas City include five high schools, eighty-eight elementary schools, four junior high schools, one junior college, one teachers' training school, two trade schools, one part-time school, ten business colleges, one dental college, one engineering college, one law college, one medical college, one optical college, thirty-two parochial schools, one automobile school, one aviation school and one tractor school.

Kansas City is a leading hotel center.

Kansas City can care for any convention, regardless of size or character. It is the fifth city in the United States in number of commercial hotels. In the past year ten new hotels have been built with more than 2,500 rooms, all with bath, and all in the downtown district. These hotels are so located that they form a circle around the business district. The diameter of this circle at its widest point is not more than seven blocks.

Their location in regard to Convention Hall is ideal. None of the larger hotels is more than four blocks away and the majority are within two and three blocks. Several have numerous meeting rooms, banquet halls, committee rooms and other convention facilities of excellent quality.

## VIENNA LETTER

(From Our Special Correspondent)

### THE RADIATING SUBSTANCES OF THE HEART

Professor Zwaardemaker has proved by a series of experiments some time ago that a frog's heart, treated with saltless physiologic solution, and thus stopped, can be put in motion by irradiating it with radium and polonium. According to this finding Zwaardemaker is ready to attribute the physiologic property of kitchen salt to an action of a similar nature. In the course of his experiments, some contradictions developed which he tried to clear up. Normally he found that the frog's heart, stopped by the saltless physiologic solution, required ever increasing, but not proportionally growing, doses of radiation to be put in motion afresh, and by reason of this he was inclined to regard the beating of the heart as due not to the direct action of irradiation but to a certain substance which was released by the irradiation, or at least activated by it. He called this substance, upon the proposal of C. E. Benjamin, "automatin." His conceptions with regard to this hypothetical matter evolved, on the basis of his experiments, are as follows: If he collected the streaming fluid of the stopped heart and then irradiated this, independently from the heart, the fluid so treated set another stopped heart in motion. According to this finding, it is probable that this substance is in the heart in a preformed state, as an "automatinogen." As regards its topographic origination in the heart, it is not localized to a certain place, as is the Dermoor and Haberlandt heart hormone, thus differing from it. It can be found not only in the musculature of the heart, but also in the muscles of the skeleton, whence it gets into the circulation and here it is also demonstrable. In the blood and muscles it is mainly an automatinogen.

### THE NEW SELF-PROTECTING DEEP THERAPY TUBE

In the Hungarian Roentgen Society, Charles Hatschek, engineer, exhibited and explained the construction of the new self-protecting deep therapy tube. The tube which is called Müller-Metwa-Metallix therapeutic lamp, bears at its center a cylinder 2.5 mm. thick, of chromic acid, and at the two ends of this the lead-glass necks of the roentgen lamp are welded. The essential protection against the rays is afforded by the 5 mm. thick lead cylinder which is imposed over the chromic acid cylinder. Against the rays emanating from the handle of the lamp and against the unnecessary rays coming from the anticathode, protection is rendered by the lead-glass neck of the tube. For the exit of the rays there is a window provided on the metal central part, which is made of 200 kv. metalixon metal, which acts also as a filter. In tubes of less voltage the window is made of glass, to which any kind of filter can be adapted directly to the roentgen tube. If necessary, easily changeable tubes can be adapted to the window serving as the exit of the rays. The lamp is water cooled, and therefore may be used with any kind of apparatus, even with rectifierless ones. They can be mounted on any stand, and although the tube is very easily movable and flexible, it provides sure protection against the primary rays in every respect.

### DRAFT OF A BILL ON THE COMPULSORY APPLIANCE OF SAFETY DEVICES

A special committee appointed by the Ministry of Public Hygiene, started to

elaborate at the Technical Experiment Station of Vienna, some reliable and certain acting devices for preventing roentgen injuries. After a long series of sittings, in which all details of the questions have been discussed, Professor G. Holzknecht has been entrusted with the drafting of a bill to be urgently recommended for passage. Professor Holzknecht did not hesitate to accept this responsible task, and, in view of the urgency of the business, hastened to perform this difficult work. In the draft he emphasizes the fact that the regulation of the application of the roentgen rays is the topic of discussion in almost all cultured states. The cause of this is that with the increase of the application of the roentgen rays in technique, industry and medicine the number of accidents caused by the electric current and by the rays themselves is every increasing. As there are laws in force for the use of steam boilers, rope-railways and traffic in poisons, it is fair that the use of the roentgen rays should also be legislatively regulated. According to his opinion two groups of controls are needed: the control of the apparatus and that of the knowledge of those dealing with them. As regards the first group, it is an undeniable fact that in the great competition to manufacture sets at reasonable prices, sometimes no adequate attention is directed towards safety. Deficient apparatus has claimed several sacrifices. Thus, for instance, in order to reduce prices, some manufacturers tried to ground one pole of the transformer and forgot that by this modification the other pole carried exactly the double of the current, and therefore the danger of this pole was enhanced. The manufacturers would be willing to give up making these but they dare not do so on account of the competition. As regards the knowledge of the roentgen operator, this would be no problem at all if would-be roentgenologists were compelled to spend two extra years in the study of roentgenology, while general practitioners who use roentgen installations in their private consulting rooms, should be allowed to install apparatus of minor efficiency, that is, less dangerous sets. Roentgen operators and technicians should pass an efficiency examination before a special committee consisting of physicians, roentgen experts and technicians.

It should be made compulsory that manufacturers of roentgen apparatus should fit up every single apparatus with all protecting appliances, to secure absolute safety, both to operator and patient. It is not admissible that the purchase of supplementary safety devices be made optional. It very often happens that while an apparatus costs, say 5000 marks, the safety device is priced at only 400 marks, and yet the purchaser refuses to buy the safety device. All safety devices should be integral parts of the machines and sold exclusively with these.

A frequent source of accidents is the unreliability of timing apparatus. The operator duly sets his timing apparatus to ring after the lapse of thirty minutes. During this time he looks after other business and forgets about his patient, relying upon the bell ringing, which, however, fails to function. The patient gets another half hour or so, the result being a severe burn. To avoid such emergencies, Holzknecht advises the use of two alarm clocks at the same time, there being practically no probability of both failing at once.

## AMERICAN COLLEGE OF RADIOLOGY

The 1928 Convocation of the American College of Radiology took place at Minneapolis on June 13, upon which occasion Alfred L. Gray, M.D., of Richmond, Virginia, took office as President. The other officers for the year are as follows: President-elect, James T. Case, M.D., Battle Creek, Michigan; Vice-president, A. C. Christie, M.D., Washington, D. C.; Chancellors, H. W. Van Allen, M.D., Springfield, Massachusetts, and Arthur W. Erskine, M.D., Cedar Rapids, Iowa.

To Mr. Clyde Snook was awarded the College Gold Medal for meritorious work in the field of radiology.

Dr. Felix Sluys, Brussels, Belgium, and Dr. Francis H. Williams, Boston, Massachusetts, were elected to Honorary Fellowships.

## SECTION ON RADIOLOGY

AMERICAN MEDICAL ASSOCIATION

The program at the meeting in Minneapolis was one of practical value and was followed with deep interest by the considerable number of radiologists present.

The officers elected for the ensuing year are: Chairman, M. J. Hubeny, M.D., Chicago; Vice-chairman, Leon T. LeWald, M.D., New York; Secretary (re-elected), Fred M. Hodges, M.D., Richmond, Virginia; Delegate to House of Delegates, James T. Case, M.D., Battle Creek, Michigan; Alternate Delegate, W. W. Wasson, M.D., Denver, Colorado.

### REACTIONS FOLLOWING USE OF TETRAIODOPHENOLPHTHALEIN

*To the Editor:*

I am making a study of the reactions which follow the use of tetraiodophenolphthalein, either orally, intravenously, or introduced into the body by any other route. I am very anxious to enter into correspondence with any physician who has observed such reactions, and who will consent to give me the details of the case or cases which have come under his observation. If any one knows of such a case, not his own, I would appreciate learning of this also so that I may take up correspondence with the doctor who was in charge of the case. That a few such accidents have occurred, I am sure; that many have occurred, I doubt very much. What I wish to do is to ascertain as nearly as possible the exact truth regarding reactions and if possible how to avoid them.

I will appreciate it very much if you will put a little note in the Journal asking any of our readers who have observed serious reactions, to please write me giving such details as they can regarding the circumstances of the case or cases.

Yours sincerely,
JAMES T. CASE.

Battle Creek, Mich.

## LANTERN SLIDE EXHIBIT

Attention is called to that part of the program for the meeting of the American Roentgen Ray Society at Kansas City which deals with the lantern slide exhibit to be held on Tuesday evening, September 25. Dr. Ralph D. Leonard, 43 Bay State Rd., Boston, Mass., is in charge of this exhibit. Dr. Leonard urges all members and guests to bring difficult and interesting case reports and slides. The meeting will be informal but Dr. Leonard would like to have all those wishing to show slides notify him previous to the session.

*Subscribers to* THE AMERICAN JOURNAL OF ROENTGENOLOGY & RADIUM THERAPY *visiting New York City are invited to make the office of the publishers (Paul B. Hoeber, Inc., 76 Fifth Avenue, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

# DEPARTMENT OF TECHNIQUE

*Department Editor:* David R. Bowen, M.D., Pennsylvania Hospital, Philadelphia, Pa.

*In this department will be published from time to time, as material is available, suggestions for improvement in technique.*

## A SIMPLE FORM OF FILM CHANGER FOR SIMULTANEOUS BILATERAL STEREOSCOPIC ROENTGENOGRAMS OF THE MASTOID REGIONS

BY HENRY K. PANCOAST, M.D.

From the Department of Roentgenology, University of Pennsylvania

PHILADELPHIA, PENNSYLVANIA

VARIOUS means have been devised for making bilateral stereoscopic pairs of roentgenograms of the mastoid regions so that both sides may be viewed simultaneously in the stereoscope. It has seemed to us that these methods have been more or less complicated and a source of error has been injected mainly because two films or cassettes have had to be used for the purpose. The 7 × 17 in. film and cassette which have recently been made available appealed to us as important aids in the solution of the problem of greater simplicity. It required but a few hours of thought and work to make up a model from which was constructed a satisfactory film changer for obtaining all four of the mastoid exposures on the one strip of 7 × 17 in. film.

The construction and operation of the device is illustrated by the diagram (Fig. 1). We had constructed for us a metal box, 31 1/4 in. long by 9 in. wide over all, and 1 1/2 in. thick. The two sides and right end were made of 1 in. channel brass, 1/16 in. thick, and the bottom of 1/8 in. bakelite. The entire top was first covered by the same thickness of bakelite, and the two end portions, A-A, by 1/16 in. lead, covered in turn by 1/8 in. sheet brass, leaving the middle 1/7 of the top covered only by the bakelite. A thin sheet iron tray (not shown in the drawing), the length of a 7 × 17 in. cassette, operates from one end of the box to the other and serves the purpose of the cassette carrier. It is open at one end, corresponding to the open end of the box, F. The inside dimensions of the box are, in length, seven-fourths the length of the 7 × 17 in. film plus the width of the two ends of the cassette frame. The width is that of the film plus that of the two sides of the cassette frame, with the addition of the small space required by the thin sides of the sheet iron tray and the room needed for it to operate freely without binding.

A thin, flexible wire cable, C, running over the pulleys, D-D, is attached to each end of the cassette tray inside, and is used for moving the tray and cassette up and down in the box. A metal marker, E, fastened to this wire, serves as a guide to inform the operator which fourth of the film is ready for exposure under the bakelite window in the top of the box. The numbers, 1-3-2-4, on the side of the box are so placed that when the wire marker, E, is opposite any one of them, that fourth of the cassette or film is located under the window for exposure.

The device is operated as follows:

1. The box is slightly longer than the width of the usual Bucky table. A metal peg near each end of the under surface of the box fits into a corresponding hole on each side of the table near its head end. This keeps the box rigidly in position after it has been placed upon the table (Fig. 2). The exact positions of the pegs and holes is important, as will be noted in the next paragraph.

2. *Placing the Tube.* The tube, which, with its holder, rests on the shifting frame,

A (Fig. 2), operating on the raising and lowering post, B, of the table, is placed at a proper distance above the box for stereoscopic work, and is tilted from above toward the box at an angle of 20°. A narrow cylindrical cone is employed under the tube. A pointer, C, is attached to the lower end of this to indicate the central ray direction. The exact position of the box on the table has been so arranged by the placing of the pegs and holes described in the previous paragraph, that when the tube holder indicator, D, is at zero on the arc scale and the post all the way up toward the head end of the table, the pointer under the cone points directly at the center of the bakelite window in the top of the box. In order to determine the proper stereoscopic shift, the tube holder is shifted on the shifting frame, A, $2\frac{1}{2}$ inches to the left, and *tilted* sufficiently to bring the end of the pointer back to the

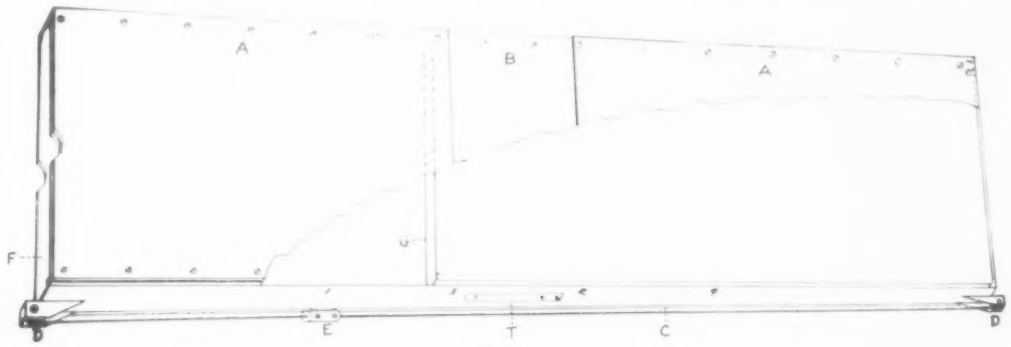



FIG. 1.

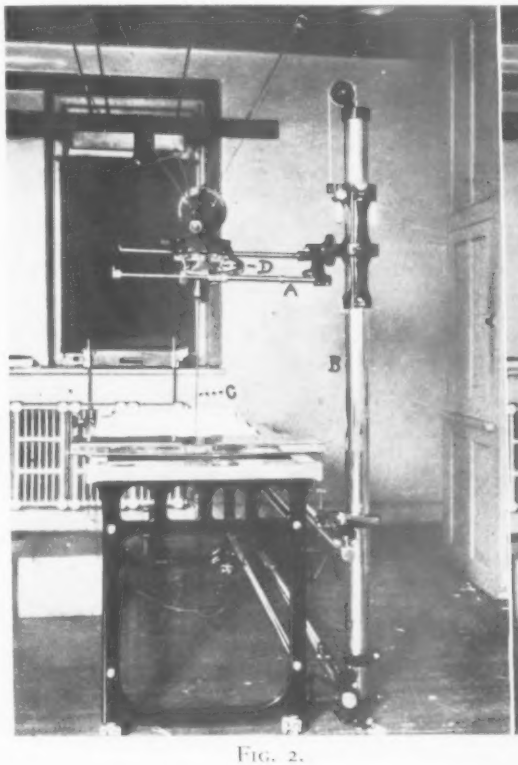



FIG. 2.

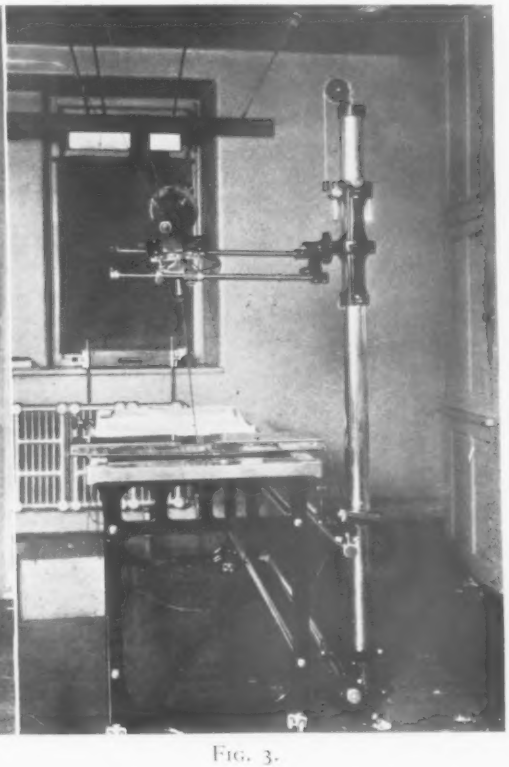


FIG. 3.

center of the bakelite window (Fig. 3). The angle necessary for this tilt is recorded. For the opposite movement, the tube

Fig. 4.

holder is then brought back to zero, shifted 2½ inches to the right of zero, tilted to the right enough to bring the end of the pointer back to the center of the bakelite window, and a record made of this if it was not the same as was necessary on the other side, which it really should be.

3. *The Patient.* The patient should lie almost prone upon the table, with the right mastoid region placed over the center of the bakelite window. A sand bag under the left shoulder is a great help. The head will be immobilized later.

4. The wire marker, E (Fig. 1), is pulled to position "4" on the side of the box. This brings the open end of the tray up to the open end of the box (F, Fig. 1). The 7 × 17 in. cassette is then slipped all the way in the tray. The marker, E, is then moved to position "1," which brings the left one-fourth of the cassette, G, under the bakelite window.

5. A canvas band with a weight at each end is then placed over the upper side of the patient's head in order to immobilize it. The weights hang over the sides of the table (Fig. 4).

6. The first exposure is then made in the longitudinal or perpendicular direction (Fig. 2).

7. The cassette tray is always held in position by a spring trigger, T (Fig. 1). This trigger is now pulled out, releasing the tray, and the wire marker, E, is moved to position "2," which shifts the cassette so that the third fourth from its left end is ready for the second exposure of this same mastoid region. The trigger again holds the tray in place. The tube is then shifted to the operator's left 2½ in. and tilted at the angle previously determined (Fig. 3). (See paragraph 2.) The second exposure is then made.

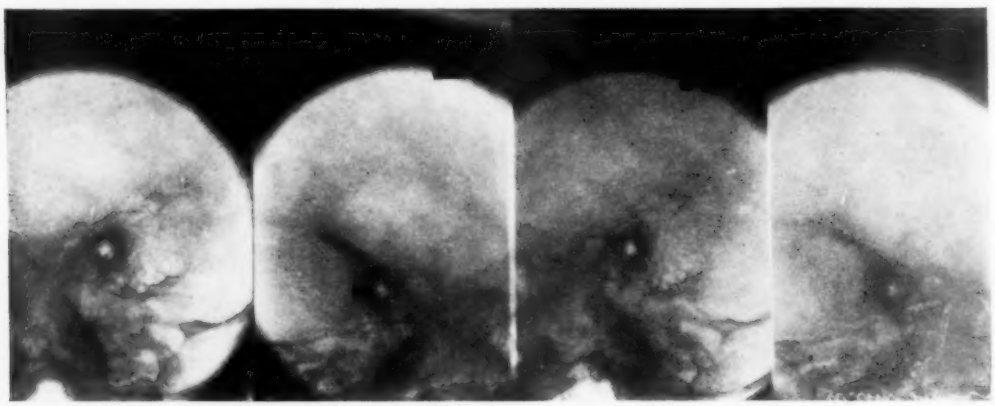


Fig. 5.

8. The trigger is released and the wire marker is moved to position "3." The patient's head is then turned over and the opposite mastoid region is placed over the center of the bakelite window and immobilization carried out as before. The

tube holder is brought back to zero on the frame and the tube is placed in the straight position, and the first exposure of the second mastoid region is made.

9. The trigger is released and the wire marker moved to position "4." The tube is then shifted $2\frac{1}{2}$ in. to the operator's right and tilted the necessary angle, and the second exposure of this side is made.

If the left mastoid is to be exposed first instead of the right, the shifting and tilting of the tube must be made in the reverse directions from those described above.

In this way all four exposures are made on one strip of film (Fig. 5). After development and drying, the strip is cut in half, and one-half is placed in each side of the stereoscope.

While this device was planned primarily for mastoid work, and incidentally is a convenient way of showing stereoscopically each temporomandibular articulation at the same time, the bakelite window and one-fourth of the $7 \times 17$ in. film are large enough to accommodate each wrist, elbow or ankle if desired.

# BOOK REVIEWS

*Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.*

Urography. By William F. Braasch, B.S., M.D., F.A.C.S., Head of Section on Urology, Mayo Clinic; Professor of Urology, The Mayo Foundation for Medical Education and Research, Graduate School, University of Minnesota, in collaboration with Benjamin H. Hager, B.S., M.D., Associate in Section on Urology, Mayo Clinic. Second edition, revised and enlarged. Cloth. Price, $13.00. Pp. 480, illustrated with 759 roentgenograms. Philadelphia: W. B. Saunders Co., 1927.

The book under review is a revision and enlargement of the author's "Pyelography." In the revision, the title has been changed as above, and the text includes pyelography, ureterography, cystography and urethrography, the numerous, well-chosen illustrations making it an invaluable reference text for all those interested in urography from the standpoint of the urologist or the roentgenologist.

The history of urography is interestingly told and a full bibliography afforded. The technique of urography is fully explained and brought up to date, emphasis being laid on the three-plate method.

One of the most valuable features of the book is the emphasis laid on the normal anatomy as revealed by the roentgenograms after injection of the portion of the urinary tract to be studied. With the numerous illustrations of the normal and its variations, the reader is greatly aided in detecting the abnormal. One section devoted to the sources of error in urography is of considerable importance, stress being laid on such errors as incomplete filling of the pelvis or ureter, overdistention, motion during exposure and external factors.

A chapter on the abnormal position of the kidney contains the significant statement that "abnormal position of the kidneys, even though marked would afford no objective data for surgical interference unless accompanied by evidence of dilatation of the pelvis or ureter."

Dilatation from obstructive hydronephrosis is divided into slight or first degree, moderate or second degree, and extensive or third degree, The etiological factors in hydronephrosis are fully discussed, and illustrative examples given. Dilatation of the pelvis and ureter from inflammation, renal and ureteral stone, are adequately covered in the sixth, seventh, and eighth chapters respectively.

The chapter on renal tumors has been enlarged, and new and valuable information added. This chapter is an index of the vast amount of material which has been studied at the Mayo Clinic, as most of the relatively rare conditions are included.

The chapter on congenital anomalies is of distinct service as both the gross and minute variations from the normal are illustrated.

The chapters on cystography and urethrography were not included in the previous text and add greatly to the value of the revised edition. The technique of examination is explained and examples given of the pathological conditions encountered.

The final chapter is concerned with such miscellaneous conditions as ruptured kidney, postoperative deformity, perinephritic abscess, perirenal fistula and idiopathic hematuria.

Medical science is fortunate to have a monograph from the Mayo Clinic on such an important subject by Dr. Braasch, in collaboration with Dr. Hager. The careful selection of illustrative cases from such a vast amount of material examined over a long period of time, make the text authoritative and comprehensive, and it is most heartily recommended.

F. O. Coe.

Grashey, R. Atlas Typischer Röentgenbilder vom Normalen Menschen. (Atlas of Typical Roentgen Pictures of the Normal Man.) Lehmann's Medical Atlases, Vol. v. Fifth improved edition. Bound. Price, 26 marks. Pp. 236, with 234 illustrations (autotypes) in original size, and 373 text figures. Munich: J. F. Lehmann, 1928.

The excellent, widely favored normal atlas appears before us again after a lapse of five years, in new array. A welcome improvement first to attract notice is the employment of a glossy printing process for the autotypes whereby the quality of the reproductions is very considerably enhanced. The introductory text has been increased by a number of pages, and has been altered and revised to include innovations and advances in knowledge, with the result that it constitutes a noteworthy small, but surprisingly full, textbook. Six new

illustrations have been added to the atlas; 16 old ones have been replaced by better ones and many of the text figures and sketches are new.

Grashey's volume is not only an indispensable reference work for the student but also offers the experienced roentgenologist a vast amount of valuable and interesting details. For the study of normal roentgenological osteology there is no better or more valuable work.

The handiwork of the printers and publishers in the production of this volume is excellent. This book in its earlier editions has already achieved an honored position in the literature and together with its mate—"The Surgical-Pathological Roentgen Pictures"—will always maintain this position.

F. Haenisch.

Voltz, F. Dosierungstafeln für die Röntgentherapie. (Dosage Tables for Roentgen Therapy.) Second enlarged and improved edition. Paper, price, 4 marks; bound, 6 marks. Pp. 145, with 21 illustrations. Munich. J. F. Lehmann, 1928.

The first edition which appeared seven years ago has been considerably improved and enlarged to include the important advances and modern conditions. Preceding the actual tables of dosage is a short introductory text covering all the valuable and necessary information regarding the general laws of roentgen radiation, the specialized concepts of dose and the various methods of measurement. At the end is a short chapter on the biological and physical technique of calibration of roentgen apparatus and tubes.

The dosage tables save a lot of trouble and work in practical roentgen therapy because the usual measurements and calculations are eliminated. This little book is a great help to the roentgen therapist and will make many friends.

F. Haenisch.

## BOOKS RECEIVED

Ergebnisse der Medizinischen Strahlenforschung (Röntgendiagnostik, Röntgen-, Radium- und Lichttherapie). Herausgegeben von H. Holfelder, Frankfurt a. M., H. Holthusen, Hamburg, O. Jüngling, Stuttgart, H. Martius, Göttingen. Band III. Paper, price, 68.00 marks; bound, 72.50 marks. Pp. 791, with 613 illustrations. Leipzig: Georg Thieme, 1928.

Matter, Electricity, Energy. The Principles of Modern Atomistics and Experimental Results of Atomic Investigation. By Walter Gerlach, o.ö. Professor, University of Tübingen. Translated from the Second German Edition by Francis J. Fuchs, Ph.D., St. John's College, Brooklyn, N. Y. Cloth. Price, $6.00. Pp. 427, with 119 illustrations. New York: D. Van Nostrand Co., Inc., 1928.

Stereoscopic Photographs of Crystal Models. Edited by Sir William and Professor W. L. Bragg. Consists of 41 stereoscopic photographs complete in box with folding stereoscope and printed description of all the models. Price £1 18 9. London: Adam Hilger, 1927.

Folklore of the Teeth. By Leo Kanner, M.D. Yankton State Hospital, Yankton, S. D. Cloth. Price, $4.00. Pp. 316, with illustrations. New York: The Macmillan Company, 1928.

Diathermy: Its Production and Uses in Medicine and Surgery. By Elkin P. Cumberbatch, M.A., B.M. (Oxon), D.M.R.E. (Camb.), Medical Officer in Charge, Electrical Department, St. Bartholomew's Hospital. Second edition. Cloth, Price, $7.00. Pp. 332, with 87 illustrations. St. Louis: C. V. Mosby Co., 1928.

A Text-book of Actinotherapy; with Special Reference to Ultra-violet Radiation. By D. D. Rosewarne, M.R.C.S. (Eng.), L.R.C.P. (Lond.), Late Honorary Actino-therapeutist and Assistant Physician, City of London and East London Dispensary. Coth. Price, $4.00. Pp. 237, with 20 illustrations, including a coloured plate. St. Louis: C. V. Mosby Co., 1928.

Lichtbiologie und Lichttherapie. Eine Vortragsreihe veranstaltet gelegentlich der Gründungstagung der Gesellschaft für Lichtforschung, September 1927 in Hamburg. Herausgegeben von Prof. Dr. Hans Meyer, Bremen, Vorsitzender der Gesellschaft für Lichtforschung. Cloth. Price, 37.50 RM. Pp. 441, with 193 illustrations. Berlin and Wien: Urban and Schwarzenberg, 1928.

Électrothérapie. Par le Docteur W. Vignal, Électro-Radiologiste des Hôpitaux de Paris. Paper. Price, 32 fr. Pp. 550, with 179 illustrations. Paris: G. Doin & Cie., 1928.

The New York Academy Lectures on Medicine and Surgery. Cloth. Price, $5.00. Pp. 319, with 39 illustrations. New York: Paul B. Hoeber, Inc., 1928.

Report on Sanocrysin (Møllgaard) Investigation. By the Sanocrysin Research Committee of Japan. Pp. 73. Tokyo: Kyorinsha Printing Co., 1927.

Atti del VII Congresso Italiano di Radiologia Medica. Paper. Pp. 578, with illustrations. Napoli: Giannini & Figli, 1928.

Bibliografia de Hidatidosis. Tomo Vi. Paper. 714. Buenos Aires: A. Guidi Bufforini, 1927.

# INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

## ROENTGEN DIAGNOSIS

Abeles, Fritz. Latent Köhler's disease of the second metatarsus. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 948–951.

Four cases are described in which the roentgen pictures showed pronounced changes due to Köhler's disease of the second metatarsus. In 3 of the cases these findings were incidental to examinations made for other purposes. No symptoms referable to Köhler's disease had ever been noted in any of these 3 cases, all of whom, aged ten to eighteen, had passed the critical age. In the fourth case, which occurred in a woman aged twenty-five suffering from evident secondary arthritis deformans, the symptoms were clearly due to the latter cause and no signs or disturbances referable to the Köhler's disease of the metatarsus during the growing age could be recalled by the patient.

These cases indicate that Köhler's disease may run a subacute or latent course. The anatomical changes seen in the roentgenogram were quite appreciable in the above cases and yet they did not seem to cause any noticeable symptoms.

Abramowitsch, Th., Warschawsky, B., and Scheinin, M. The roentgen diagnosis of pneumoconiosis (chalicosis and siderosis). *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 952–958.

In well-advanced cases of pneumoconiosis, a definite clinical symptom-complex is present which renders diagnosis easy. In the earlier stages the disparity between the clinical and roentgenological findings is characteristic. Roentgenologically the early stages of pneumoconiosis are not very characteristic. The changes in the lungs caused by the action of various dusts (chalicosis and siderosis) are largely similar and usually not differentiable roentgenologically. The deposition of dust in the lungs depends on the duration of exposure, on the character of the dust and on the individual disposition of the organism.

Pneumoconiotic changes are always localized in the middle and lower portions of the lungs, while the apices remain free. This point may be of importance in differential diagnosis. The differentiation between pneumoconiosis and tuberculosis is different only in the far-advanced cases. The net-like marking and the symmetrical distribution of the large sharply outlined foci is characteristic for pneumoconiosis. Tuberculosis, on the other hand, shows an asymmetry in the apico-caudal development and a largely nodose, cirrhotic character of the process. In cases of concurrent tuberculosis and pneumoconiosis a diagnosis is possible only after an analysis of all the clinical findings.

Six illustrations are given representing four distinct groups. The first represents cases in which the changes are not characteristic and in which the roentgenograms show only intensified and enlarged hilus shadows. The second group represents cases with roentgenologically clear-cut changes, characterized by net-like lung marking with symmetrical foci distributed in the middle portions of the lungs. The third group represents the combination of tuberculosis and pneumoconiosis. The lung apices are not free. The roentgen pictures are those quite similar to the productive, often cirrhotic form of tuberculosis which develops into the exudative type terminally. The fourth group represents the coarsely nodular form of pneumoconiosis with thickening of the pleura and the lung tissue which often bear resemblance to neoplasm.

Adson, Alfred W. Osteitis fibrosa cystica of the spine. *Surg. Gynec. & Obst.*, May, 1928, xlvi, 684–689.

Two cases of osteitis fibrosa cystica of the spine are reported with the purpose of emphasizing the fact that the disease occurs in other than the long bones of the body, that trauma and infection are suggestive etiological factors and that roentgenograms are of diagnostic value in differentiating bony tumors. The cases also show the value of surgical treatment in these benign giant cell tumors.

In attempting to differentiate foreign body giant cell tumor and malignant tumor of the spine, especially in children and young adults, one must take into consideration the history of trauma and infection and examine the roentgenograms carefully. The roentgenograms of a foreign body giant cell tumor will present a shell-like tumor with spicules of bone irregularly placed within the tumor, presenting rarefied areas due to the cystic formation, differing in this way from the punched out appearance presented by metastatic lesions, from the solid enlargement of osteomas, from the radiating trabeculations of sarcoma and

from the destructive process incident to cold abscess formation in tuberculosis.

If there is doubt in the surgeon's mind concerning the diagnosis, it is well to give the patient the benefit of an exploration since surgical removal of the tumor and relief of pressure from the cord will bring about not only restoration of function but permanent cure as well. All, or as much as possible of the tumor should be removed and the remaining portion should be curetted thoroughly; the remainder of the wall in the body of the vertebrae should be rongeured away or crushed into the cavity permitting the osteoblasts to restore the bony defect.

The first case occurred in a boy aged fourteen, complaining of paralysis of the lower extremities. Roentgen-ray examination of the chest was negative. Roentgenograms of the dorsal and lumbar spines revealed destruction of the right half of the tenth dorsal vertebra with more or less circumscribed shadow between the tenth and eleventh ribs suggestive of tumor; and multiple shadows were noted in the left renal area with calcified vertebral lymph nodes opposite the third lumbar vertebra on the right. The diagnosis was obviously compression myelitis due to tumor. Because of destruction of the body of the tenth dorsal vertebra on the right, it was surmised that the lesion might be a myeloma, a giant cell sarcoma or a foreign body giant cell tumor of the osteitis fibrosa cystica type. An exploratory laminectomy showed the mass to be definitely cystic, the tumor tissue being diagnosed by the pathologist as benign foreign body giant cell tumor with hemorrhagic cyst formation. As much of the shell-like portion of the mass was removed as possible and the contents of the rest of the cavity were curetted. As a precautionary measure, a course of deep roentgen therapy was carried out postoperatively. Convalescence has been uninterrupted.

The second case occurred in a girl, aged thirteen, who had already received roentgen treatment for a suspected tumor of the upper region of the cervical spine. The roentgenogram of the cervical spine revealed a cyst-like tumor situated posteriorly and to the left, apparently springing from the second and third cervical vertebrae. The roentgen examination was of extreme value, since it demonstrated the shell-like tumor which made the diagnosis of foreign body giant cell tumor possible and encouraged the performance of exploratory laminectomy. This case was treated like the first and recovery was complete.

Akerlund, Åke. Later experiences concerning the niche diagnosis in cases of duodenal ulcer. *Acta radiol.*, 1927, viii, 538–546.

Niche diagnosis in cases of duodenal ulcer has made great progress recently owing to the routine application of the technique of direct bulb compression, a method which permits one to study closely the surface contour of the bulbar wall. The direct compression should be applied and graduated under roentgenoscopic control. The direction of pressure should probably not be made dependent on the direction of the projection of the rays. The simplest way of compressing the bulbar region is by means of cotton, cork or aluminum pads placed between the cassette holder and the patient. The technique of bulb compression not infrequently makes it possible to demonstrate small and superficial niche formations within the bulb, formations which without compression appear roentgenologically entirely or almost normal. Compression of a deformed bulb will often bring out an otherwise invisible niche towards which the folds of the mucosa converge not infrequently. The niches on the anterior or posterior wall of the bulb are found nowadays much more frequently than the so-called classical contour-forming niches on the lesser curvature with corresponding deep depressions on the opposite side; a fact which is probably due as much to the altered technique as to an alteration in the material observed. With the compression method it is often possible to reveal multiple ulcers. Thanks to this method, the demonstration of bulbar niches has become far more frequent than ever before, even in the very early stages. In practically every case where it has been possible to check the findings by operation or autopsy, the roentgenologically diagnosed niche was found anatomically to correspond to the crateriform ulcer.

Arens, Robert A., and Bloom, Arthur R. A case of calcified thyroid. *Radiology*, October, 1927, ix, 333–334.

Because of the apparent rarity of calcified thyroid, the authors give only brief mention of such a condition in a patient aged sixty-seven. There were no symptoms referable to the thyroid, and the calcified thyroid was found accidentally during a routine examination. The patient had been suffering from abdominal distress after meals, loss of appetite, indigestion, belching and nocturia. There was nothing in the history or symptoms which indicated thyroid involvement. The roentgenogram showed a calcified mass in the left cervical region, which was shown to be calcification of the left lobe of the thyroid. The trachea was deviated to the right and showed compression. The patient was not operated on.

Arisz, L. An investigation into defects in the pyloric part of the stomach. *Acta radiol.*, 1927, viii, 274–288.

In a rather large proportion of roentgen examinations of the gastric walls, defects are found in the pyloric part. The defects under consideration are not the large easily recognized ones due to tumors but rather small defects that do not change the general gastric contour to an important degree. These defects are outlined definitely by a smooth curve and they are seen during the examination when the pyloric wall is relaxed. These defects are of the order of a few millimeters in width and depth and may cover a distance of 2 or 3 cm. of the gastric outline. Operation in such cases usually discloses a duodenal ulcer but no evidence of ulcer at the site of these particular deformities. Such defects are usually found in a great proportion of all gastric examinations. They occur in cases where duodenal ulcer is present as well as in cases without any ulcer. They occur mostly on the greater curvature in patients with a sthenic habitus in a zone reaching up to 3 cm. before the pyloric ring; on the lesser curvature they are found in all types of stomachs in a zone reaching up to about 2 cm. before the pyloric ring; a very typical and frequent site is the neighborhood of the pyloric canal. These defects have never been found to cause irregularity in peristalsis.

Frequently there occur defects of rather large size not interfering with peristaltic movements and the clinical evidence indicates that they are caused by large folds of the mucous membranes. Benign tumors giving rise to such folds are rarely encountered. Likewise malignant tumors are seldom seen of the size comparable with these folds. The changes produced by the peristaltic waves on the shape of the defects is quite typical and may be regarded as a sign of diagnostic value. If a defect does not change its shape in this way, one may suspect that it is not due to a fold in the mucosa but to some other factor. A number of illustrative observations are cited.

Buchman, Joseph. Traumatic osteoporosis of the carpal bones. *Ann. Surg.*, June, 1928, lxxxvii, 892–910.

Many hypotheses have been advanced to explain a rare condition more commonly called Kienböck's disease of the carpal semilunar and Preiser's disease of the carpal scaphoid. These authors describe what Buchman believes to be different manifestations of a similar process and for which the latter submits the term given in the title as more appropriate.

Seven cases are reported, in 3 of which the scaphoid was affected. In the fourth case both the scaphoid and the semilunar were involved. The fifth case presented osteoporosis of the semilunar, scaphoid and os magnum. The sixth case showed osteoporosis of the semilunar, os magnum, and the unciform. In the seventh case the os magnum and the unciform were similarly affected. All of these cases, with the exception of the second, sixth and seventh gave a definite history of injury. Only 4 of the cases were treated, 2 conservatively and 2 by the operative removal of the offending bones. Of these, one of the non-operated cases is doing very poorly, while all of the others have good functional results. Rarefaction or osteoporosis is the outstanding pathologic state in this condition, hence the term "traumatic osteoporosis" is believed to be the most appropriate name for the condition described.

In the great majority of semilunar cases the roentgenograms are at first apparently negative. At a later date the semilunar bone presents areas of rarefaction and areas of more intense calcification. The entire bone is darker than the other adjacent bones. The proximal portion is involved first. The bone becomes thinned in its vertical or short axis and widened in the anteroposterior axis. As the disease progresses the proximal portion may become fragmented and portions may disappear. The proximal convex surface becomes flattened and irregular, and the entire bone is thinned. In those cases which had a severe injury, there may at times be a compression fracture. Other changes secondary in nature are of an osteoarthritic character. The head of the os magnum may be displaced upward. The articulating surfaces of the radius may show osteoporosis and the points of insertion of the ligaments may become roughened. Most authors state that from the very beginning a very fine line of fracture may be noted on very careful study. Kienböck is inclined to believe that this fracture is secondary and pathological in nature.

Roentgenographic studies of the scaphoid show that the characteristic appearance may be present as early as the second day after the injury, but this is unusual. First there may appear one or more small circular or oval areas of halisteresis or rarefaction in the center of the bone. These soon fuse into one large area of lessened density. It is through this area that a fracture appears later. Constriction at the middle of the body occurs and the bone presents darker and lighter areas, areas of absorption and eburnation. The entire bone is darker than the surrounding bones. In the

late stages, secondary osteoarthritic changes take place. The pathogenesis of these conditions is unsettled. The author's microscopic sections show fibrous tissue replacement of bone and marrow, and increase in the blood vessels. The bony structures are thinned.

CARTY, JOHN R. An inguinal granuloma of unknown origin associated with bone changes. *Radiology*, October, 1927, ix, 334–335.

This is a report of a young man who was referred for treatment of granuloma of both inguinal regions. In 1915 the patient had bilateral inguinal adenitis and the lymph nodes showed chronic inflammation due to infection. The lesion began as a hard painless verrucous plaque in the right inguinal region. This then broke down centrally, and a similar condition developed on the left side. Rectal examination showed perirectal infiltration. The Wassermann reaction was negative; the stools showed no ova nor parasites, and the blood count showed slight anemia. Before starting roentgen treatment, a complete roentgenographic study of the bones was made. It was found that there was marked destruction and production of bone, with destruction predominating. Roentgen-ray therapy, consisting of eighteen medium wave aluminum-filtered treatments, was given at three-week intervals to both inguinal regions. There were two rest periods of eight weeks. Following the first two treatments the exudate disappeared and a steady improvement was noted. As the lesions healed, the affected areas became pigmented. Aside from this effect, the general health of the patient is much improved.

CASTRONOVO, E. Syndrome of cholecystitis from ascarids with a negative cholecystographic picture. *Radiol. med.*, May, 1928, xv, 469–472.

A case is described in a patient aged twenty, who had the typical picture of cholecystitis. The roentgen picture showed ascarids in the bulb of the duodenum and they were judged to be the cause of the disease for as soon as they were expelled the symptoms stopped and the patient is still well four months later. This case is particularly interesting because a cholecystography by the intravenous method was negative, but the rapidity with which the clinical symptoms disappeared showed that there had been no real inflammation of the gall-bladder but that the symptoms had been caused reflexly by the ascarids. Great caution must be exercised in interpreting the results of cholecystographic tests as they may depend on purely functional factors.

CHAUMET, G. A method of interpretation of orthodiagrams of the heart based on the establishment of some numerical indices. *J. de radiol. et d'électrol.*, Nov., 1927, xi, 561–572.

The surface of the orthodiagram of the heart of course does not give accurate information in regard to the enlargement of the organ. The author also makes some criticisms of Lian's method and gives diagrams showing his own method of calculating the total index of the left ventricle, which is the most important segment in enlargement of the heart. In addition to this index of the left ventricle he makes use of the quotient determined by dividing the index by the sum of the transverse diameter and the cord of the right ventricle. The normal index of the left ventricle is between 55 and 65 and the normal quotient between 2 and 3, average 2.50. The surface is also taken into account but it is less important. Tables are given showing the pathological conditions which correspond to the various measurements of the index and quotient.

CHOISY, R., and BABAIANTZ, L. On volvulus of the stomach. *Acta radiol.*, 1927, viii, 410–418.

There are two distinct forms of volvulus of the stomach: (1) total volvulus, and (2) partial or subtotal or of the pyloric section. The present discussion is concerned with the second type. The symptoms of total volvulus are quite sharp and the clinical diagnosis may be easily made, but the symptomatology of partial volvulus is not so distinct nor easily diagnosed. This form has often been found as a complication of gastric disease at operation or at autopsy. Torsion of the stomach is not a very common occurrence and is rarely a permanent condition. Spontaneous untwisting will occur if the torsion is not greater than 180°.

A report is given of a case occurring in a woman aged forty-one. Clinically there was an abdominal syndrome characterized by intermittent pain and vomiting, intestinal stasis and pneumatosis and vesical retention. Subsequently amenorrhea set in. The first roentgen examination quite clearly presented evidence of volvulus of the stomach. Three days later a second roentgenological examination showed that the stomach had resumed a natural position. An exploratory laparotomy revealed no organic lesion either of the stomach or neighboring organs.

CUNNINGHAM, T. D. A source of asthma in children. *Radiology*, October, 1927, ix, 280–284.

The author made use of the roentgenogram

to show infection in the sinuses and the lungs of children suffering from asthma. The areas infected were very clearly shown by roentgenograms, and illustrations are submitted. Sinus infection in children has not been considered possible by some authorities, but these findings show conclusively that even three-year-old children may have deep-seated sinus infection which in turn gives rise to asthma.

David, Vernon C. Pseudo-carcinoma of the stomach. *Ann. Surg.*, April, 1928, lxxxvii, 555–565.

There is a small group of middle aged patients having unusual lesions of the stomach which resemble carcinoma clinically, which upon exploratory laparotomy are found to have lesions other than carcinoma. In some instances, these unexpected lesions are amenable to surgical relief. This group of patients may have palpable tumors of the stomach or large roentgen-ray filling defects of the stomach, or both, accompanied by symptoms which might well be those of carcinoma. The clinical histories of 4 patients presenting unexpected pathology of the stomach are presented. The first case occurred in a woman aged fifty-nine in whom the roentgen-ray diagnosis was penetrating ulcer of the lesser curvature of the stomach, most probably malignant. Operation disclosed a phytobezoar 4 × 5 × 3 inches in size, and on the lesser curvature was a large penetrating ulcer, the base of which was found adherent to the under surface of the liver. A subsequent post mortem showed the ulcer to be non-malignant. The second case occurred in a woman aged fifty, in whom the roentgen examination showed a constant defect in the antrum reaching up to the pyloric ring. A diagnosis of carcinoma of the stomach was made and an exploratory operation was performed. A large tumor mass was found on the greater curvature with enlarged glands of the neck, mediastinum and peritoneal cavity which receded with good recovery. Microscopic examination showed this to be a case of Hodgkin's disease. The enlarged glands receded under roentgen therapy. This seemingly primary involvement of the stomach by Hodgkin's disease is not common. The third case occurred in a woman forty-eight years of age and gave a roentgen diagnosis of tumor of the stomach, probably carcinoma. Operation showed a pedunculated tumor on the greater curvature of the stomach almost filling the stomach cavity. The tumor looked grossly like a large lipoma, but on microscopic examination was found to be a spindle cell sarcoma. The fourth case occurred in a woman aged sixty-four and showed on roentgenoscopic examination of the stomach that the antrum was markedly narrowed for a distance of 4 in. from the pylorus. This deformity remained constant. The films showed canalization of the antrum. The diagnosis was almost surely carcinoma. An exploratory operation disclosed a hard tumor mass which roughly maintained the outline of the stomach but which had converted the wall of the stomach into a contracted, hard tubular mass. This indurated area stopped abruptly at the pylorus. There were no enlarged regional glands. There was no gross ulceration of the mucosa. The histological examination showed no evidence of carcinoma. No area in the sections looked at all like tuberculosis or syphilis. This case obviously falls in the category of linitis plastica.

It is concluded therefore that the following different conditions may all be easily confused with the usual carcinoma of the stomach, and should be carefully excluded before exploratory operation is denied a patient apparently suffering with inoperable carcinoma of the stomach: foreign bodies in the stomach, chronic granulomas, chronic inflammatory lesions, tumors other than carcinoma and inflammatory fibromatosis.

D'Istria, A. A case of marble bones (Albers-Schönberg's disease). *Radiol. med.*, May, 1928, xv, 473–485.

A case of marbling of the bones is described in a patient aged thirty. The bone changes involved the whole skeleton. The blood picture was very little changed and the chief features of the clinical picture were remarkably poor physical development and a tendency to fracture of the bones. He had had three fractures, two of the lower limbs as a result of falls and one of the inferior maxillary resulting from extraction of a tooth. The author reviews the clinical picture and the little that is known of the pathogenesis of the disease, showing the antagonism between it and osteopsathyrosis. It has been suggested that this disease, as well as osteopsathyrosis, is endocrine in origin. The author thinks it may be due to an opposite functional change in the same glands, probably the parathyroids, though these are perhaps not the only glands involved. The poor physical development, the failure of the fontanelles to close, the retardation of organ function and the disproportion in the development of the different parts of the body suggest that the disease may be due to dysfunction of the endocrine glands which preside over the normal development of bone, the thymus, thyroid and hypophysis.

EDITORIAL. Thoracic contrast media roentgenography. *Surg., Gynec. & Obst.*, February, 1928, xlvi, 292–294.

The limitations of unaided thoracic roentgenography are less marked because the air in the lungs acts as a normal contrast medium bringing structures into sharp relief and accentuating the shadows of inflammatory or neoplastic increase in density. There have been, nevertheless, very serious limitations to the roentgen diagnosis of thoracic disease. A uniformly thickened pleura or a pleural effusion clouds the contrasting effect of the air in the lungs and effectively masks coexisting lesions. Intrapulmonary shadows that are revealed may also be of uncertain or indeterminate significance. The heart and dome of the diaphragm overshadow markings of lung pathology. Air-containing dilatations or cavities or strictures of bronchi may produce no definite findings. The exact status of fistulous tracts and empyema cavities is not demonstrable without the use of suitable contrast media.

The greatest use of the various contrast media is in the differential diagnosis of bronchiectasis which next to tuberculosis is the most common chronic pulmonary disease. Bronchiectasis coexisting with thickened pleura, empyema, tuberculosis, or subphrenic abscess can be recognized with certainty only by such contrast visualizations.

Pulmonary abscess with wide open communications with a large bronchus may be directly visualized with iodized oil if empty, or after having been emptied bronchoscopically, but the oil may fail altogether to gravitate into those with imperfect drainage, notably those situated peripherally. In empyema the method is of great value in establishing the presence and ramifications of bronchial or intrapleural fistulous tracts or multiple communicating cavities. In pulmonary tuberculosis the method serves to outline cavities and secondary bronchiectasis, but cases have been reported seeming to show that the iodine gradually set free may stimulate the tuberculous process to renewed activity.

ELSBERG, CHARLES A. Extradural spinal tumors—primary, secondary, metastatic. *Surg., Gynec. & Obst.*, January, 1928, xlvi, 1–20.

A general report is presented on all the extradural and intradural tumors excepting intramedullary and metastatic extradural growths operated on in the author's clinic up to September, 1927. There were 46 cases of extradural tumor and 133 cases of intradural tumor. Of the total there were 2 cases presenting both extradural and intradural tumors.

Exclusive of intramedullary tumors and of metastatic extradural and intradural growths, about one-fourth of all spinal tumors are extradural. The meningeal and perineurial fibroblastomas constitute 17 per cent of the extradural and 82 per cent of the intradural tumors; sarcomas and chondromas 61 per cent of extradural and 6 per cent of intradural growths.

In general, the clinical course of extradural tumors is more rapid, sudden exacerbations of symptoms not unusual, exaggeration of symptoms and signs after withdrawal of fluid of lumbar puncture very frequent. The early symptoms are often vague in character: root pain infrequent, contralateral motor disturbances and paresthesias and the reverse Brown-Séquard syndrome often observed. The increase of globulin or total protein is rarely, if ever, as marked as in intradural tumors, and in many of the vertebral disc chondromas there is no evidence of subarachnoid block by the manometric tests.

Of the extradural tumors 52 per cent in the author's series were primary and 48 per cent secondary. Many of the primary extradural growths are benign and encapsulated and completely removable. The meningeal and perineurial fibroblastoma, the fibroma, angioma and chondroma are usually single. The primary extradural chondroma occurs in two forms; in one the growth lies in the extradural space on the ventral or dorsal aspect of the dural sac, in the other the growth is derived from and firmly fixed to an intervertebral disc. The primary extradural sarcomas occur in two forms; in one the growths are derived from the dura and have no tendency to become adherent to or involve the walls of the vertebral canal; in the other, they begin within the canal and erode the bone to grow outwards forming hour-glass or dumb-bell shaped tumors.

The secondary tumors grow into the vertebral canal either through intervertebral foramina or by bone erosion. They arise from the vertebrae or paravertebral soft tissues and may be extensions of growths in the thorax or deep tissues of the neck or back. The spinal cord symptoms are due either to the pressure of the extradural part of the growth or to interference with the blood supply of part of the cord; and the symptoms are, excepting in the chondromas, more acute in their onset and more rapidly progressive. The chordomas are true secondary extradural tumors although their clinical course was as slow as that of many benign extradural and intradural tumors. The spinal cord symptoms of metastatic

extradural growths are usually rapidly progressive and bone destruction visible roentgenographically is very frequent. The symptoms are often due to interference with the blood supply of part of the cord or to the collapse of the bodies of one or more vertebrae.

Most of the primary and many of the secondary extradural tumors can be completely removed. The complete removal of metastatic and of some primary and many secondary extradural tumors is impossible. More than one-third of the patients with primary or secondary extradural tumors can be greatly improved or permanently cured. The proportion is larger in the primary than in the secondary and in benign than in malignant tumors.

Erdélyi, Josef. The importance of the roentgen examination of the aorta in clinical diagnosis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 958–963.

A brief discussion is presented of the various roentgenoscopical changes in the aorta in relation to the conditions causing these changes and which should be taken into consideration in interpreting the findings clinically. It is important to know the age of the patient, size, and body weight, other diseases, and the clinical findings with a bearing on the present condition.

In considering the ascending aorta, a heightened convex curvature should not be considered characteristic for syphilitic aortitis because this sign is not found regularly in this disease. The occurrence of a smaller or larger convex curvature of the ascending aorta depends on circumstances which are independent of the aorta. An increased arterial pressure is a major factor influencing the shape of the aorta. The author does not believe there is justification for the statement that an aorta marked by a sharp boundary proves the existence of sclerotic change in the wall. A serrated contour of the ascending aorta seen roentgenographically is not considered a certain sign of syphilitic disease of the wall. Furthermore, an augmented pulsation of the ascending aorta is not a characteristic sign of syphilitic aortitis. The aortic arch can change its position during breathing, swallowing and coughing. The rigid sclerotic arch performs typical movements during the act of swallowing. Changes in the shape of the long and pathologically lengthened aorta yields more differential diagnostic evidence than mere measurements of length. The manifestly lengthened aorta may cause a deficiency of air in the left pulmonary apex. In considering the diameter of the aorta, one of the important problems of the roentgenologist is to determine, if possible, whether the aorta is pathologically dilated or not. The author directs attention to the fact that there is no sharp boundary between the healthy and diseased aorta and that the diameter of the aorta varies considerably in individual cases with the age, weight and living conditions.

Garcin, J. Cholecystography: Results and value of the test with tetraoidid given by mouth. *J. de radiol. et d'électrol.*, Oct., 1927, xi, 513–534.

Examination of the gall-bladder is not now considered complete without roentgen examination after the administration of an opaque medium. The author finds that the use of tetraiodid by mouth is simple, harmless and effective. The salt can easily be given in the food. The greatest disturbance that it ever causes is a little nausea and diarrhea. Even this does not always occur and it is so slight and transitory that it can hardly be considered an argument against the use of so simple and effective a method. In the course of the past year the author has used the method in 52 cases; the gall-bladder was clearly visible and normal in 16, clearly visible and deformed in 3, clearly visible and hypertrophied in 4, it was slightly visible in 3, invisible but containing visible calculi in 11 and invisible and free of calculi in 15. So the total of positive cases, including the ones in which only calculi were visible, was 37 out of 52 cases, or 70 per cent. Only 11 of these were cases of visibility of calculi alone, leaving 50 per cent visible gall-bladders. These positive results alone would justify the use of the method, even in the eyes of those who refuse to consider the negative results. And while it is true that invisibility of the gall-bladder after the tetraiodid test does not prove that the organ is pathological, it at least renders it very probable, and a factor that is of value in association with the clinical symptoms.

Goette, K. The roentgenological representation of the cerebellum. *Acta radiol.*, 1927, viii, 340–344.

Satisfactory roentgenograms of the cerebellum can be obtained with encephalography after puncture of the cistern, the head being inclined forward. The patient is examined in the sitting position. Lateral roentgenograms are taken with the head bent forward. The fronto-occipital roentgenogram is taken after the head is slowly raised. The gas quantities introduced into the cistern are not very large (15 to 40 c.c.). A report is given of a case

occurring in a woman aged thirty-eight suffering for several months with a dizziness and headache followed by symptoms of brain pressure. The roentgenograms showed a large gas-containing cavity in the middle and right cerebellar region extending through a large portion of the posterior cranial fossa. This finding taken in conjunction with the fact that the suboccipital insertion of the hypodermic needle had yielded a sticky, slightly cloudy, yellowish-green fluid, clouding in a few minutes, pointed to a diagnosis of a cerebellar cyst. Roentgenogram taken four days later showed some of the injected air had disappeared and was replaced by fluid. The condition of the patient became alarming as the cyst again became filled with fluid and operation was performed at which the diagnosis was confirmed.

GRANT, FRANCIS C. The value of ventricular studies other than ventriculography in the localization of brain tumors. *Surg., Gynec. & Obst.*, May, 1928, xlvi, 689–695.

No single factor is more vital to the successful extirpation of a brain tumor than precision in its localization. In a certain number of cases, although the presence of a tumor is unquestioned, no definite clue can be obtained as to its situation. Heretofore, to solve this problem a ventriculogram was necessary. But as experience with ventriculography increased, the effect upon the size, shape and position of the ventricles of tumors placed in different brain areas became more clearly appreciated. It soon became apparent that if a definite routine were adopted in the tapping of the lateral ventricles, the estimating of the amount of fluid removed from each and the determining by injection of a dye whether the interventricular foramina were patulous, a very shrewd guess could be made as to the abnormality in the ventricular outline that the roentgen films would subsequently reveal. This procedure of attempting to determine the position of the lateral ventricles by plunging for them from a fixed point, of estimating their relative size by the amount of fluid recoverable from each, and lastly of discovering whether or not the interventricular foramina are patulous by the injection of a dye has been termed by Dandy ventricular estimation. Since bilateral ventricular tap without replacement of the fluid by air is unquestionably safer than ventriculography, this has seemed sufficient justification to attempt to discover the value and limitations of this less hazardous method of tumor localization.

In a series of 26 cases in which ventricular estimation had been employed as an aid in diagnosis, 19 were subsequently verified at operation or necropsy. The interpretation was correct in 18 instances, incorrect in one. Three illustrative cases are cited. It is concluded from this study that ventricular estimation is a safer procedure than ventriculography. In experienced hands with proper interpretation it may often give information of equal value. Asymmetry of the lateral ventricles is very strong evidence of a cerebral tumor on the side of the smaller ventricle. A symmetrical hydrocephalus usually indicates a cerebellar tumor. However, it is under these circumstances that an error may be made from ventricular estimation alone, unless the clinical syndrome points to the cerebellum. If doubt exists, it is wiser to perform a ventriculogram in the presence of hydrocephalus.

HERULF, GUSTAF. Contribution to the question of mode of procedure in periodical röntgenological examinations under identical positions of the patient, mainly in dentistry. *Acta radiol.*, 1927, viii, 303–316.

A series of roentgenograms depicting a particular portion of the body obtained at different times under identical conditions as to position and exposure is called by the author "periodical-identical roentgen series" abbreviated p.i.r.s. Extra-oral p.i.r.s. are obtained as follows: The desired points of entrance and exit of the central ray are marked on the skin of the patient and kept so marked during the period of examination. The central ray thus oriented should always be made to fall on the roentgen film at right angles. Under these circumstances, the line connecting the points of entrance and exit may be considered an axis about which the object to be examined can be rotated into new positions without causing changes in the resulting picture. To produce intra-oral p.i.r.s., the position of the roentgen film in relation to the part to be examined is reconstructed by means of a dental cast. The position of the head is worked out with the aid of a cast and a special molding spoon, together with a chair especially designed for the purpose. This chair is provided with a frame whereby the direction of the central ray can be reproduced mechanically. A number of roentgenograms are given showing the precision with which the roentgenograms can be reproduced after successive intervals.

INGBER, E. The possibility of roentgen diagnosis of different kinds of union between the atlas and occiput. *Radiol. med.*, June, 1928, xv, 578–584.

On the basis of the new classification of Tramontano-Guerritore which includes four very distinct groups of union between the atlas and occiput, the author, with the aid of five roentgen figures, shows that it is possible for roentgenologists to make an exact diagnosis of these different forms of union during life. He did not make this study simply from a theoretical or scientific point of view, but because of the practical need of such a differential diagnosis, which it is to be hoped will be made in the future in many clinical cases.

JUNGHAGEN, SVEN. Lymphogranulomatosis in the stomach. *Acta radiol.*, 1927, viii, 317–339.

A lymphogranulomatosis of the stomach can occur in two different forms, one, a partial phenomenon of the generalized form of the disease and the other a localized disease confined to the stomach. The latter is the so-called tumor form of the disease. The roentgen appearances related to these conditions are described in detail.

In the first case, the roentgen picture obtained suggests very closely a gastric ulcer, provided there are not present multiple ulcers in an extensive indurated zone which would lead the examiner to suspect a malignant disease. Malignancy would also, of course, be suspected if the changes continued to progress in spite of conservative treatment.

In the case of the tumor form of the disease, which is usually localized in the pyloric region, there occurs a fairly circumscribed tumor causing stenosis of the lumen. When the lymphogranulomatous granulation tissue does not invade or only partly infiltrates the muscular layer there is a definite motility of the contour which, taken together with the striking sharpness of the cuff-shaped, fairly extensive stenosed region, may be considered a specific sign of this stage of the disease. In other respects, the roentgen appearance conforms largely with that found for cancer of the stomach.

The author suggests that linitis plastica may be identical with lymphogranulomatosis of the stomach.

JUNGMANN, MARTIN. The early roentgen diagnosis of pregnancy. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 913–928.

The roentgen visualization of the fetus is possible from the eighth to ninth week of pregnancy onward by employing the best roentgenographic technique with the aid of compression and the Bucky diaphragm. The author describes a compression tube which is recommended in this connection. In order to be able to perceive minimum differences in contrast, an optimal darkening of the roentgen plate is necessary. The roentgen diagnosis of pregnancy is an early diagnosis and is the first definite sign of pregnancy to appear long before other definite signs become available. It is, however, emphasized that at the present time only a positive roentgen finding has any significance. A negative finding is significant only under certain conditions. Optimal conditions for studying the roentgen films must be observed if the roentgen signs of pregnancy are not to be missed. The method is entirely harmless to both the mother and child and may be carried out conveniently in any modern roentgen establishment. Further improvements in the roentgenographic technique will increase the reliability of the diagnosis.

KESSEL, LEO, and HYMAN, HAROLD T. Some unusual and atypical intrathoracic conditions. *Am. J. M. Sc.*, April, 1928, clxxv, 511–523.

Bronchoscopy is not sufficiently employed in the diagnosis of obscure pulmonary conditions where it is a necessary procedure. Intrathoracic diseases often offer grave diagnostic difficulties. The authors have collected examples of unusual clinical conditions or atypical manifestations of common intrathoracic conditions. Most of these are represented by illustrations and comprise the following conditions: (1) Intrathoracic accidents; (*a*) acute spontaneous pneumothorax; (*b*) perforating lesions of the esophagus; (*c*) traumatic effusions; (*d*) collapse of the lung following trauma. (2) Postoperative complications; (*a*) collapse of the lung; (*b*) postoperative embolism. (3) Special pulmonary complications following operative procedures in the nose and throat; (*a*) acute bronchopneumonia following bronchoscopy; (*b*) lung abscess; (*c*) pneumococcus pneumonia following tonsillectomy; (*d*) activation of pulmonary tuberculosis following tonsillectomy. (4) Lung abscess following dentistry. (5) Foreign bodies. (6) Influenzal pneumonia. (7) Pulmonary manifestations of acute rheumatic fever. (8) Lobar pneumonia. (9) Pulmonary tuberculosis. (10) Neoplasm of the lung. (11) Atelectasis of the lung.

LAURELL, HUGO. The roentgen symptoms in a case of intra- and retroperitoneal inflammation, and the early roentgenological signs of acute osteomyelitis. *Acta radiol.*, 1927, viii, 289–302.

A description is given of a case occurring in a woman aged twenty-six, suffering from appendicial abscess clinically difficult to inter-

pret, in which roentgen examination gave valuable information. In addition to the usual well-known roentgen symptoms of retroperitoneal inflammation, there could be seen in the right side a distinct subcutaneous network consisting of dilated blood vessels. These vessels were so deeply situated in the well-developed peniculis adiposus that they escaped detection on external examination. They remained practically unchanged for several weeks. In the author's opinion, this vascular network is not only a sign of active hyperemia but also and mainly a sign of an inhibition of the venous outflow from the abdominal wall; this was probably due mainly to thromboses in the deep veins of the abdominal wall where these veins in the retroperitoneal tissue pass behind the colon and where they may be easily injured by a paracecal inflammation. The author also suggests that distended lymph channels were also concerned in the development of these subcutaneous vascular networks.

Attention is drawn to the fact that similar vascular networks, visible only with roentgen rays, are observed in children suffering from acute osteomyelitis of the extremities in cases where the peniculis adiposus is well developed, thus preventing the detection of these vessels by external examination. This roentgen symptom together with a diffuse swelling of the soft parts and disappearance of the normally visible intramuscular septa in the diseased area, can be determined roentgenologically during the stage of the disease when no skeletal changes are as yet demonstrable.

Lysholm, Erik. Plastic röntgenograms of the digestive tract. Preliminary report. *Acta. radiol.*, 1927, viii, 571–574.

A method is described for bringing out the detail of the mucous membrane or of pathological changes on the anterior or posterior walls of the digestive tract when filled with opaque substance. The aim is to obtain a cast of the inner surface of the organ and photograph it on the roentgen plate with the same definition as that obtained of the impression on a coin. It is necessary to experiment with different concentrations of opaque material to obtain the proper detail. The roentgen tube should be operated at 100 to 150 kv., 100 to 200 ma., time of exposure should not exceed 0.8 sec.

Meisels, Emil L. Spondylolisthetic pelvis in a man. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 979–985.

This rather unusual pelvic deformation due to a gradual slipping of the body of the fifth lumbar vertebra forward and downward from the upper surface of the sacrum, has been described mostly in women. However, more recently reports in the literature show that it may occur in laboring men. This condition is apparently known as miner's back amongst the miners of South Wales. The case reported occurred in a twenty-year old railway laborer. A lateral roentgenogram of the sacral lumbar region disclosed a pronounced forward and downward displacement over the base of the sacrum of the fifth lumbar vertebra which was bent downward. Its horizontal axis was practically parallel with the vertical axis of the whole body. The lower surface of this vertebra lay along the anterior surface of the first sacral vertebra, both surfaces forming a sharp angle opening downward. The body of the fifth lumbar vertebra was short and low, its dimensions being distinctly smaller than those of the fourth. The vertebral arch was long and joined the vertebral body with the articular processes and the spinous process, the lower surface of which rested on the base of the sacrum. A split-like irregular absence of bone was visible roentgenographically only on the left side of the vertebral arch. Owing to the pronounced lordosis of the lumbar vertebra, there was a considerable constriction of the intervertebral spaces, this being very distinct between the second and third and the fourth and fifth vertebrae. The latter space presented the appearance of a triangle with its apex pointing up and down. The base of this triangle was almost 2 cm. in length. The body of the fourth lumbar vertebra lay obliquely with its anterior surface facing the symphysis, its oblique position formed a transition between the horizontally placed third vertebra and the almost vertical position of the fifth. The fourth lumbar vertebra was slightly irregular and trapezoidal, its posterior surface shorter than the anterior, being slightly curved and presenting on its lower edge a diagonal defect. The upper surface was drawn out to a point and lay in contact with the lower surface of the third lumbar vertebra. The roentgenographic picture in the sagittal view confirmed these findings.

Montgomery, Albert H. Hodgkin's disease of bones. *Ann. Surg.*, May, 1928, lxxxvii, 755–766.

A report is given of a case occurring in a boy aged nine, who showed primary bone involvement of the leg. There was also moderate sized tumor under each angle of the jaw. In the back of the neck, mostly on the right side, there was a tumor about the size of a plum which was

deeply seated. This tumor could be moved slightly but seemed to be attached to the spine or base of the skull. A roentgen examination showed a tumor mass involving the spinous process of the second cervical vertebra. There was a large swelling of the right tibia occupying its middle third. It was spindle shaped and raised about 2 cm. at its highest point. It occupied the inner surface of the bone, the sharp edge of the tibia being uninterrupted. There was no tenderness or signs of inflammation. There was no general enlargement of the lymph nodes, although nodes were palpated in the neck, axillae and groin. A detailed description is given of this case including necropsy report. In this case lymphatic involvement could not be demonstrated until two and a half years after the onset of the disease. Perhaps if more detailed explorations of the bones could be made marrow involvement might be found in most instances of this disease. At any rate, it would seem advisable in every case of Hodgkin's disease to make a roentgenological examination of the entire skeleton. This could be supplemented by a biopsy of any suspected areas in the bones. The information thus obtained would add materially to our knowledge of the disease, and in certain cases where the bone seems to be involved primarily, it would be a most valuable diagnostic procedure.

From a review of the literature and from the history of the case reported, it is concluded that Hodgkin's disease may exhibit a primary bone involvement simulating a bone tumor or osteomyelitis. It seems that bone involvement, either primary or secondary, may be more frequent than is generally believed in Hodgkin's disease. The vertebrae are the most frequent site of involvement, often presenting a pressure myelitis simulating Pott's disease. The marked eosinophilia in the tissue sections in Hodgkin's disease points to an essential irritation and involvement of the bone marrow in this disease and should lead to a careful examination of the osseous system in such cases.

MOORE, C. ULYSSES. Rickets of the lower extremities: its relation to genu valgum and static flat-foot. *J. Bone & Joint Surg.*, January, 1928, x, 96–103.

The skeletal signs of rickets appear in the various bones at the time of their most rapid growth; consequently the chief manifestations during the first six months of life are in the flat bones of the head, as in craniotabes; during the first year in the bones of the chest, as in costomalacia, rosary, and Harrison's groove; during the second year in the extremities, as enlarged epiphyses, genu valgum or varum and pes planus. At puberty the bones of the extremities have a second period of rapid growth, thus fostering a recurrence of rachitic manifestations. Static flat-foot is often noted for the first time at this age. Rachitic lesions produced in puppies and rats well illustrate some of these skeletal defects, and roentgenograms of these animals demonstrate the differences in the deposition of calcium.

In bipeds the situation is more complicated than in quadrupeds because the bone construction is less simple. At the knee the epiphysis of a young child is irregular, is separated from the diaphysis and lies at a considerable distance from its articulating fellow. The epiphyseal plates, nevertheless, should meet this basic requirement: approximating borders of a hinge joint should be parallel.

Signs of rickets in the bones of the head or chest at any time during the first year of life indicates that rickets of the legs and feet will probably appear during the second year and possibly again at puberty. Roentgenograms of the legs of young animals and of children show that in early rickets the weight of the body causes the joint lines at the knee to form an acute angle instead of being parallel. The amount of lateral mobility at the knee is an accurate index of the degree of leg rickets in the early stages and later demonstrates the progress being made toward a cure. The knee mobility arthrometer has proved a valuable and inexpensive means of taking such measurements rapidly.

Studies indicate that static flat-foot is a form of rickets. During rapidly growing periods the ends of the metatarsal bones are so soft that the formation and maintenance of a normal arch is impossible. The presence of static flat-foot is easily determined clinically by noting the amount of inward rotation of the scaphoid bone when the patient stands "on his toes" and settles slowly back onto his heels. Mechanical deviations are helpful in curing rachitic deformities of the legs and feet which have become fixed, but do not prevent a return of the condition unless antirachitic therapy is administered concurrently. The aim in the treatment of rickets should be not only to improve the existing dyscrasia, but also to prevent its recurrence in the offspring.

MORTON, DUDLEY J. Hypermobility of the first metatarsal bone: The interlinking factor between metatarsalgia and longitudinal arch strains. *J. Bone & Joint Surg.*, April, 1928, x, 187–196.

Study of a large number of feet demonstrates

that the inner pillar of the foot very often presents a condition of instability which is conducive to painful disorder both in the metatarsal region and in the longitudinal arch. This instability of the inner pillar is traced to the articulation of the inner cuneiform bone with the scaphoid and also to the undue amount of play between the inner and middle cuneiform bones. Naturally the motion is manifested most conspicuously in the most distant unit of this segment of the foot and for this reason the term "hypermobility of the first metatarsal" is used to designate the condition. The associated symptoms in the metatarsal region duplicate to a considerable extent those of a short first metatarsal bone (metatarsus atavicus), but in some of the cases the symptoms have been found confined to the longitudinal arch, resembling those of foot strain. The range of symptoms and the relationship of this hypermobility with metatarsal and with arch disorders are readily understood when its effect upon the foot's mechanism is studied.

The roentgen-ray findings in this condition, as in metatarsus atavicus, are most characteristically depicted in the dorsoplantar view of the foot. The increased size of the shaft of the second metatarsal bone as compared with the size of the three outer ones is the outstanding morphological characteristic. In many of the roentgenograms taken of such cases there is a very definite cleft between the inner and middle cuneiform bones, much more than would be expected normally. Such a cleft or separation is highly suggestive of the abnormal amount of play permitted between these two bones. Variations in the plane of their adjacent surfaces, however, and its relationship to the direction of the central beam will naturally influence the distinctness with which this feature appears on the film. In short, physiological hypertrophy of the second metatarsal bone is the most notable structural feature. It is similar to the enlargement of this bone observed in feet with a short first metatarsal.

Metatarsalgic symptoms are more frequent than the symptoms of arch strain, although pain may coexist both in the forepart of the foot and in the arch. Subjective symptoms rarely appear before adult life, although the laxity of the first metatarsal bone seems to be a condition acquired congenitally or during early childhood.

Analysis of a large group of metatarsalgic cases in which hypermobility or brevity of the first metatarsal was present (singly or in combination) indicates that the disorder is essentially a physiological one, consisting of an improper distribution of stresses borne by the different metatarsal bones. It is not attended with any measurable change in the relative position of the metatarsal heads as inferred by the term "depressed anterior arches." This term is therefore regarded as inapt, and as conducive to misapprehension of the real nature of static disorders in this part of the foot.

Mouchet, A. Some unusual pictures due to ossification which might be mistaken for fracture. *J. de radiol. et d'électrol.*, Dec., 1927, 625–626.

The author has often been struck by unusual pictures of the epitrochlea and calcaneus in adolescents. It is not an anomaly of development such as is seen in certain bipartite bones, but simply an unusual appearance seen temporarily at a certain stage of development of the bone. In the epitrochlea he generally saw this picture in children from nine to twelve years of age. The bone is crossed obliquely by a sort of fissure or cartilaginous line which is parallel to the joint cartilage at the upper part of the bone and runs into it at the lower part. At this age the epitrochlea is separated from the shaft of the humerus only by a thin line of cartilage.

The picture is still more disturbing and still more resembles fracture in the calcaneum. There is a supplementary tip of the calcaneum which at about the age of twelve is still separated by a line of cartilage from the rest of the bone. At this time for some months or perhaps for a year a line can be seen at this place which divides the supplementary bone into a very narrow upper part and a much larger lower one. It looks very much like a fracture as it has jagged edges. If there has been an injury of the foot it is perfectly natural to mistake it for a fracture. The diagnosis cannot always be made by comparison with the opposite side because often this line of cartilage only appears on one side. However a picture should always be taken of both sides.

Notkin, Louis J. Gastro-oesophageal carcinoma: Its diagnosis. *Surg., Gynec. & Obst.*, May, 1928, xlvi, 717–724.

Malignant lesions of the cardia and of the stomach fundus frequently offer great difficulties in diagnosis. This is particularly true of early cases before the onset of marked loss of weight, anemia and cachexia. About 15 per cent of all malignant gastric lesions are situated at the fundus or cardia. There is no definite symptom-complex pathognomonic of carcinoma of the fundus or cardia. The tendency

of malignant lesions of the cardia and fundus to give rise to gastric and esophageal symptoms respectively is responsible for many errors in diagnosis. Dysphagia is the most important symptom and may not be directly due to the lesion, but to an associated spasm. A slowly developing dysphagia, progressively becoming worse, with remissions occurring early, if at all, is strong evidence in support of a diagnosis of malignancy. Loss of appetite, gas eructations and pain are the most frequent and early symptoms, but they are present in so many other conditions that they have only secondary importance. Malnutrition, cachexia and loss of weight are late manifestations and their absence does not constitute evidence against malignancy. Enlarged supraclavicular glands are rarely present and if present occur late. Achylia and anemia are not reliable signs but are of secondary importance. Occult blood in the stool is an almost constant finding.

Esophagoscopy is of little or no value as an aid to diagnosis, except in carcinoma beginning in the lower esophagus, particularly in the presence of malignant ulceration. The most important method of diagnosis is careful roentgenoscopic and roentgenographic examination in all positions. From the roentgenologic point of view there are two pathological groups of fundus and cardia cancer: (1) infiltrating flat growths, associated with shrinking (scirrhous type); (2) the fungating, cauliflower type of growth. The medullary type of tumor, which in the rest of the stomach gives rise to a filling defect is seen in the fundus as a tumor shadow jutting into the gas bubble which may divide the barium stream as it enters the stomach. This type of tumor growth gives comparatively little difficulty in diagnosis. It is the flat, squamous cell type that is troublesome. To diagnose cancer at the cardia, one must depend upon irregularity of the cardia and of the terminal portion of the esophagus as direct signs. The direct signs of gastro-esophageal cancer are: (1) tumor shadow bulging into the gas bubble; (2) irregularity of the barium contour as it passes through the cardia, and (3) splitting of the barium stream on entering the stomach. The indirect signs are: (1) spasm of the esophagus or cardia; (2) disturbance of the cardia mechanism; (3) absence of the gas bubble; (4) shrinking of the stomach; (5) drawing of the stomach upward and to the left; (6) increased distance between the upper pole of the stomach and the diaphragm; (7) narrowing of the fundus, and (8) obliteration of the triangular space mentioned by Howarth and Rehfuss. Two illustrative cases are cited.

Nussbaum, A. Dorsoplantar roentgenograms of the foot. *Fortschr. a. d. Geb. d. Röentgenstrahlen*, 1927, xxxv, 995.

In dorsoplantar roentgenograms of the foot either the toes are overexposed or else the tarsus is covered by an impentrable haze. To avoid these difficulties, the following procedure is recommended. First, the foot is exposed with soft rays. Next, while the hardness is gradually increased, a lead plate is moved, beginning with the toes, over the foot. This plate is moved forward and backward over the tarsal bones. In this way, it covers the major portion of the distal part of the foot and permits corresponding greater exposure of the denser portions. The result is a considerable increase in the detail obtained in the roentgenogram.

Ochsner, Alton, and Nesbit, Wellwood. Bronchography. Introduction of iodized oil into the tracheobronchial tree by the passive method. *Am. J. M. Sc.*, February, 1928, clxxv, 175–184.

Because of the complexity of the methods employed in introducing contrast substances into the tracheobronchial tree, bronchography has had a rather limited application, but it is a well-recognized and invaluable procedure in diagnosing any obscure pathologic conditions of the tracheo-bronchial system. The passive introduction of contrast media extends the application of bronchography to a much larger group of cases because of its simplicity and because it is neither unpleasant nor dangerous to the patient. Contrast substances should be introduced into the tracheobronchial system under the roentgenoscope and observed roentgenoscopically. The passive introduction of these substances, especially favors roentgenoscopic observation.

The technique of passive introduction of contrast material into the trachea involves temporary cocaine anesthesia of the posterior pharyngeal wall together with the anterior pillars. The degree of anesthesia is determined by the mobility of the larynx. As soon as the larynx upon attempted deglutition remains immobile, the anesthesia is complete. This anesthesia wears off within two to three minutes, thus eliminating the danger of aspirating any other substance. Because of this only temporary anesthesia it is essential to place the patient under the roentgenoscopic screen immediately after the completion of the anesthesia. He is instructed to take the iodized oil (1 to 2 oz.) which is previously warmed, into his mouth. The head is tipped backward and the body leaned slightly to the side which it is desired to fill. In this position

the patient is instructed to take short breaths, during which time the iodized oil is aspirated into the trachea. This entire procedure is done under the roentgenoscope and the mode of filling very carefully observed. The roentgenoscopic examination in these cases is more important than the interpretation of roentgenographic plates. During roentgenoscopy the patient is turned in different directions, thus eliminating the possibility of making a false diagnosis of dilatation of the bronchial tree due to the superposition of two bronchi. Occasionally one finds that the alveoli fill so quickly that haziness is produced which obscures the underlying bronchial picture. In this way a bronchial dilatation may be overlooked if the roentgen-ray plate alone is relied upon.

Three illustrative cases are cited. Bronchography is especially indicated in those cases presenting chronic pulmonary symptoms and should not be denied a patient who is suspected of having tuberculosis. In a series of over 700 cases no untoward signs or symptoms have been observed following a bronchography obtained by the passive introduction of contrast material. The iodized oil in the tracheobronchial tree seems to have a decided therapeutic effect in cases of chronic pulmonary infections.

Panner, H. J. A case of vertebra plana (Calvé). *Acta radiol.*, 1927, viii, 547–554.

A report is given of a case, which occurred in a farmer aged twenty-two years, with symptoms which Calvé described under the designation vertebra plana. The disease is evidently of considerable chronicity for in the present case the first symptoms appeared nine years previously and the patient is not yet cured. The roentgen examination showed serious changes, namely, a pronounced kyphoscoliosis over the lower thoracic vertebrae, and a very much diminished vertical diameter of the body of the ninth thoracic spine. There were no signs of spondylitis or of any other known destructive disorder. Though benign as compared with spondylitis, the disease can produce considerable changes both pathologically and anatomically akin to those seen in severe cases of Calvé-Perthes' hip disease. The latter and vertebra plana probably belong to the same category of juvenile growth diseases. It will probably be a difficult matter to determine in the individual case when the disease has finished its course, and whether the existing symptoms are due to the affection itself or to its consulting consequences.

Pemberton, John de J. Malignant disease of the thyroid gland: A clinical consideration. *Ann. Surg.*, March, 1928, lxxxvii, 369–377.

The clinical study of 457 cases of malignant disease of the thyroid (276 operative and 181 nonoperative) is summarized as follows: The frequency of carcinoma of the thyroid as compared with benign nodular tumors is 2.7 per cent; as compared with benign enlargements, 1.66 per cent. The age incidence corresponds to that in cases of carcinoma in general. The malignant lesion predominates in the female in the ratio of two to one. In 87 per cent of all the cases there was definite evidence of a preexisting benign goiter. Pathologically the malignant tumors were classified as sarcoma, 1 per cent; diffuse carcinoma, 25 per cent; carcinoma in fetal adenoma, 38 per cent, and papillary adenocarcinoma, 30 per cent. Even in the absence of a characteristically hard, irregular, nodular tumor, fixed to the neighboring tissues, malignancy should be suspected in all tumors of the thyroid in which there has been recent rapid growth with or without associated hoarseness and paralysis of a vocal cord. The clinician suspected the malignant nature of the tumor in only 35 per cent of the operative cases and the surgeon suspected it in 69 per cent. Metastasis occurs frequently and often early in the course of the disease. Operation supplemented by irradiation is the choice of treatment. The adenoma must be looked on as a precursor of malignancy; although the danger entailed by the retention of an adenoma cannot be computed, it is not over 2.7 per cent.

The results of the surgical treatment of carcinoma of the thyroid are more encouraging than is popularly believed. Of the 204 patients operated on during the years 1907 to 1923 inclusive, 66 (32 per cent) are living after a lapse of from three to eighteen years. These results are influenced for the most part by the type of the growth and the grade of malignancy. Of those with sarcoma none is alive. Of those with diffuse carcinoma, 21 per cent are alive; with carcinoma in fetal adenoma, 38 per cent and with papillary adenocarcinoma, 48 per cent. In cases in which malignant disease was diagnosed before operation 32 per cent of the patients are living three years or longer.

Piersol, G. M., and Bockus, H. L., and Shay, Harry. The diagnostic value of duodenal drainage in gall-stone disease. *Am. J. M. Sc.*, January, 1928, clxxv, 84–96.

An analysis of 57 proven cases of gall-bladder disease warrants the following conclusions: A characteristic pigment, the so-called bilirubin

calcium pigment, has been found in the bile drained from the duodenum with sufficient constancy to give it significance in the diagnosis of gallstones. It is believed that this pigment is distinct from and should not be confused with other elements found in bile, commonly referred to as pigment. Of 42 cases of cholelithiasis drained preoperatively, 73.8 per cent showed this pigment or cholesterin or both in the bile obtained from the duodenum. All of the cases having both cholesterin crystals and pigment in the bile obtained by biliary drainage proved to be cases of gallstone. In the majority of cases these elements were only found in the dark bile.

In only 35 per cent of proven gallstone cases were the stones visualized by oral cholecystography, whereas in the same series a preoperative diagnosis of stones was made from duodenal tube findings in 47 per cent of cases. A preoperative estimate of gall-bladder function from the duodenal tube examination proved correct in 88 per cent. On the other hand, a similar estimation by oral cholecystography was found correct in only 65 per cent of cases. The authors emphasize the value and importance of properly carried out duodenal biliary drainage in the diagnosis of gallstone disease. It is believed that this method has not been supplanted by any other diagnostic procedure.

One must be forced to consider that bile can be obtained from the gall-bladder by drainage in a fairly large percentage of cases in which visualization is absent, otherwise it would be difficult to account for the presence of cholesterin and pigment in these cases. In 34 stone cases there were 9 instances where more than one drainage was necessary before cholesterin crystals and characteristic pigment were obtained. An average of three drainages was necessary before positive microscopic findings could be made.

In considering gastrointestinal roentgen-ray findings in 18 gallstone cases, marked irregularities resembling those often seen in adhesions were found in the stomach or duodenum in 5 cases. These defects were of the minute incisura variety; definite subtraction from the outline of the shadow cast by the opaque meal. They were not necessarily persistent but when present in one position were shown on all film exposures in that position. Films taken on the upright patient are more apt to show such deformities. These defects are usually in the distal 2 inches of the stomach or duodenal bulb. There seems to be a tendency to ignore such defects and ascribe them to temporary spasm, drag from gastroptosis, etc. In every instance confirmed at operation such defects were found caused by adhesions from the gall-bladder.

Pottenger, F. M. Certain factors militating against accurate correlation of physical and roentgen ray examinations of the chest. *Am. J. M. Sc.*, May, 1928, clxxv, 676–683.

The findings on physical and roentgen-ray examination of the lungs show some variation in nearly all instances, and in a smaller percentage the differences are very marked. The ability of the disease process in the lung to produce shadows depends upon the power of the various elements making up the structures to intercept the rays, and this varies approximately as the fourth power of the atomic number of their composing elements. Therefore, on the plate small lesions may show perfectly if composed of elements whose atomic number is high, and large ones may not show at all if the atomic number of the chief component elements is low.

Lesions nearest the plate (taken at a distance of 40 in.) show best because the tissues nearest the tube are overpenetrated and consequently fail to intercept the rays and produce shadow. Therefore, there is considerable variation in plates taken anteroposteriorly compared with those taken posteroanteriorly. If a small lesion lies near the surface of the chest wall nearest the tube, it may not be detected at all by the roentgen ray. This error is lessened but not eliminated if the tube is some distance from the patient. When small lesions are suspected on physical examination, the patient should be placed dorsoventrally if the lesion is suspected anteriorly, and ventrodorsally when suspected posteriorly or, what is better, plates should be taken in both directions.

Rieder, H. Antiperistalsis and retrograde displacement of gastrointestinal contents. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 891–912.

In a case of hour-glass stomach and in another of stenosis of the pylorus cinematographic roentgen examinations were made. In the first case, typical antiperistalsis was demonstrable; in the second case it was atypical. The undulations in the first case progressed continually from the pyloric region toward the cardia, being repeated every eight to ten seconds. This antiperistaltic movement begins each time at the greater curvature with large undulations and ends with smaller ones. While antiperistalsis is an active process occurring in the wall of the stomach or intestine, the retrograde displacement of the contents is a process which takes place through passive contractive movements of the con-

tents. In several of the abdominal hollow organs (duodenum, small intestine, colon) passive movements running alternately ortho- and retrograde with appreciable displacement of the contents but no undulations were demonstrated by the author. In stenotic processes of the duodenum especially and also in cases of mechanical effect on the duodenum irregular backward and forward flow of the duodenal contents was definitely demonstrated by serial and cinematographic roentgen pictures. Such movements were demonstrable for several years in the case of a patient suffering from chronic stenosis of the duodenum. Similar displacements in the colon can also be studied in the normal and pathological cases. Similar retrograde displacements of the contents were brought out very clearly by roentgenography during spasms of the colon.

Emphasis is placed upon the need for distinguishing very clearly between antiperistalsis and retrograde movement of intestinal contents and thus to stimulate further studies upon the motor processes involved. It would seem desirable for the immediate future, at least, to use the term antiperistalsis more cautiously. It is particularly unfortunate that both the above terms have been used carelessly and sometimes synonymously so that the literature on the subject is difficult to follow.

Rossi, A. Roentgen and clinical diagnosis of metastatic tumors of bone. *Radiol. med.*, June, 1928, xv, 586–599.

The clinical study of secondary tumors of bone should be revised, and for this purpose it is necessary to resort to roentgen pictures, which are invaluable in this task. The author illustrates this article with many roentgenograms from his practice and draws the following conclusions from them. In patients who have been operated upon for a tumor or who are suffering from one it is not necessary that there be a spinal syndrome or a fracture before the roentgen picture can show the cause of a condition which may have been suspected from clinical observation; on the contrary, roentgen observation may show a diffuse carcinosis of the skeleton in patients in whom there has been nothing more than a slight arthritic syndrome of the neuralgic type, and it serves as a guide, in the absence of any tumor that can be demonstrated clinically, in looking for the primary focus which may have remained unknown and latent for years. Sometimes there may be a tumor that is demonstrable clinically, but it is necessary to determine whether it is inflammatory or neoplastic in nature and the roentgen examination will show a diffuse metastasis of the spine which has developed without causing the slightest symptom. Or pain may develop suddenly in the epiphysis of a bone, simulating an acute disease, but roentgen examination will show metastasis from tumor of the kidney or prostate, though on operation or histological examination this tumor may appear to be benign. The author also shows that roentgen examination has sometimes demonstrated metastases appearing a few days after operation. These metastases develop slowly and a post-operative roentgen treatment might sometimes be blamed for having caused them.

Schmidt, Walter. Experimental studies on the question of the core (densest) shadow in exudative pericarditis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 964–974.

The question as to whether it is possible to visualize the heart roentgenologically as a denser shadow within a pericardial effusion (core shadow) in pericarditis is still a disputed one. There is no doubt that in a great majority of the examined cases of pericarditis this core shadow was not visible. Nevertheless, more recent literature reports a number of cases verified at autopsy in which the roentgen picture revealed this sign.

Experimental studies on the eviscerated or with the heart *in situ* are of limited value. However, a case was obtained which was especially favorable for an experimental investigation under conditions closely resembling the pathological conditions of the living organ. In this case there was a widely dilated pericardium of large capacity. It was found that the quantity of exudate alone is uniformly without effect on the appearance of the core shadow. Post-mortem experiments show that other factors such as the manner of distribution, the density of the fluid in the pericardium, and the roentgenographic technique, singly or combined, do not yield the desired differentiation. The same result was obtained in experiments on the phantom, which besides applying the various factors already tried in the cadaver experiments, also considered the pathological topography.

Shadow differentiation can be obtained distinctly by superposition of several shadow structures lying one behind the other, as opposed to absence of superposition in the zone surrounding the shadow. This theoretical possibility is fulfilled in the living subject in mediastinal pleuritis, posterior mediastinitis, in burrowing abscess, and in induration of the pleura and pericardium in certain localizations.

In the infrequently occurring core shadow in exudative pericarditis, the cause of the phenomenon must be, in the absence of a mediastinal shadow producer, due to some other intensifying effect—the pericardial induration. Such a case was actually observed, the partially thickened pericardium yielded a core shadow. In order to bring out slight differences in shadow density it is desirable to employ correct illumination and to work with photographic material of high sensitivity because in this way it will be possible to obtain the maximum of intensification produced by the various superposed shadows. Where a summation of shadows is absent, a differentiation between the pericardial effusion and the heart shadows can still be obtained in the phantom by means of soft or medium roentgen rays; in this connection, the density of the pericardial fluid seems to be immaterial, at least within the pathological limits ordinarily found. Moreover, when the fluid column is high, the demonstration of the heart shadow in the phantom can best be obtained with very hard radiation and when the pericardial fluid is of high density. These slight shadow differences will not enable any differentiation of the heart shadow *in situ* in the living patient (pulsations of the heart).

The distinct formation of a core shadow finds a definite physical explanation in the summation or superposition of shadows; consequently the observation of this phenomenon in exudative pericarditis suggests that factors occasioning a summation of shadows must be looked for. In existing cases of exudative pericarditis a core shadow formation is possible in occasional cases, but hidden; this central, denser marking is caused by one of the above-described shadow intensifying factors but is not identical with the heart silhouette. The possibility of producing a core shadow of the heart in the true sense of the term must therefore be denied.

Schneider, Paul, and Eisler, Fritz. Hysterosalpingography. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 1007–1034.

The roentgenoscopic visualization of the uterine cavity and the tubes is considered an important advance in gynecology. Although many favorable reports on the non-irritability of iodipin were available, the authors made observations of their own on this point. Histological examinations of the tubes several days after their filling with iodipin showed no signs of a local irritation. Repeated tests for patency of the tubes at intervals for several weeks likewise appeared to have no irritating effect on the mucosa. In addition, clinical observation of all cases observed showed that even larger quantities of this oil seemed to be tolerated without any irritation by the peritoneum. Up to the present, no general signs of a sudden or slow iodism have been encountered, even where as much as 10 c.c. oil was introduced into and absorbed by the abdominal cavity.

The applicability of the method of hysterosalpingography is very wide. Contraindications for the technique should, for the present, be considered the same as those applying to the Rubin test for patency of the tubes. This means the exclusion of all cases of acute inflammatory processes, neoplasms and pregnancies. The authors go into details as to the advantages of the method and its slighter danger as compared with the Rubin technique. Successful hysterosalpingography depends quite considerably on a satisfactory technique in filling the uterus. To make the method generally applicable the manipulation should be reduced to a minimum and should not cause the patient pain or symptoms. A suitable set of instruments is described which includes an injection tube with four different adjustable uterus points, two bullet forceps, a syringe and a manometer. Details of the technique of injection are described and the authors claim that injection of the contrast oil controls the pressure and roentgenoscopy may all be carried on by one person. This procedure has been followed for the past nine months by the authors, during which time over 100 cases have been examined more or less systematically. Emphasis is placed on the fact that not a single patient showed the least signs of injury or irritation. Preliminary observations on the physiology of the organs involved show that hysterosalpingography may be expected to bring to light important observations regarding the physiology of the uterus and the tubes. Possibly a method may be developed to serve as a functional test of these organs. In addition, a considerable number of pictures are presented showing the value of the method in diagnosis.

Sherman, Julius. Carcinoma of the esophagus. *Am. J. M. Sc.*, January, 1928, clxxv, 79–84.

A report is given based upon 50 cases, 2 of which are reported. Special emphasis is placed on the type of case in which the cancer grows outward toward the submucosa and is not recognized by the endoscopist.

Although carcinoma of the esophagus is of comparatively slow growth and for a long time a purely local process, the thoracic surgeon has

made little progress in its cure because it is rarely seen by him in its early stages. Dysphagia, always considered in textbooks as an early symptom, is in reality a late symptom. This is especially true of the cases in which the growth beginning deep in the mucosa grows excentrically. These do not have large indurations or annular constrictions until late. The earliest symptoms are nervousness in swallowing and a feeling of the food sticking and finally going down, which must emphatically be considered as symptoms of possible malignancy. Intermittent dysphagia is present in all cases at some stage. Roentgen examination and esophagoscopy are the most reliable methods of diagnosis in the early stages. There are cases in which the malignancy grows outward toward the submucosa. Often an esophagitis occurs in the region of the lesion and the endoscopist mistakes this condition for a cancerous growth. In either case if other indications strongly suggest the presence of carcinoma of the esophagus, the esophagoscopy and biopsy must be repeated as shown in 25 per cent of the cases reviewed.

Erroneous diagnosis may be due to dependence on inferential instead of objective evidence, or to the antiquated and even dangerous use of the bougie as a diagnostic aid. A diagnosis of neurotic condition is frequently made in the early stages of cases that have later been proven to be cancer of the esophagus. Another common error is to make a diagnosis of spasm after a history of intermittent stoppage of food with normal intervals. The only hope for a cure of cancer of the esophagus lies in early resection. Life has been prolonged by a combination of gastrostomy, proper food by tube, plenty of water by mouth and deep roentgen-ray treatments. The cure by radium is very questionable, yet there may have been some palliation in a few cases.

Stirling, Calhoun, and Rollings, H. W. Diverticula of the bladder. *Ann. Surg.*, May, 1928, lxxxvii, 742–750.

Diverticulum of the urinary bladder has ceased to be a rare finding as a result of the more universal application of cystoscopy and cystography in lesions of the lower urinary tract. This improvement in the diagnosis has shown diverticula to be present in from 5 to 7 per cent of patients reaching the prostatic age. Trabeculae and small saccules are frequently seen in cases presenting obstructive symptoms, whereas the diagnosis of true diverticulum of the bladder is limited to those cases possessing a distinct orifice with herniation of the entire bladder wall and excludes such anomalous conditions as urachal cysts, hour-glass bladder, etc. Congenital factors play an important rôle in the etiology of these cases. Obstruction at the bladder outlet converts the potential hernias into true diverticula.

Cystoscopy in conjunction with serial cystograms affords a very accurate method of diagnosis and should be practised in prostatics unless definite contraindications exist. The size, number, location and relation to the ureteral orifice can usually be ascertained by cystoscopy. A plain urogram should always precede any operative procedure on the urinary tract. This precludes the possibility of overlooking a stone in the ureter, kidney or in a blind diverticulum. The cystoscopic findings should always be corroborated by cystography, as the latter is more accurate in determining the exact size and whether or not the diverticulum empties completely. One should not rely on the cystoscopic diagnosis alone as the size of the diverticular orifice is no criterion as to the capacity of the sac. A series of three or more plates should be made, consisting of an anteroposterior view, a lateral view to show the retrovesical type, and one after the bladder is emptied to see if retention in the sac occurs. A contrast cystogram filling the bladder with air after draining the sodium iodide solution aids in the diagnosis. Emphasis is placed on the value of an opaque catheter coiled up in the diverticulum as well as a lead catheter in the ureter on the affected side. This enables one to form a definite idea as to whether or not the ureter is incorporated in the diverticulum. It also serves as a guide in removing an adherent diverticulum which is adjacent but not included in the ureter.

This report is based on a study of 12 cases, 7 of which are briefly reported, 6 presenting unusual features. One had a relatively rare dumb-bell type stone in the bladder and diverticulum; the second, a diverticulum of the bladder associated with the diverticulum of the ureter; the third an enormous diverticulum with eight associated diverticula present which held 32 oz.; the fourth, a large diverticulum of the bladder of a female without obstruction; the fifth, a diverticulum of the bladder with both ureteral orifices opening in it, associated with enormous hydroureters and hydronephrosis; the sixth, a large vesical calculus associated with two diverticula of the bladder. Seven of the 12 cases were operated on successfully; 3 were inoperable as a result of cardiorenal disease; the remaining 2 had palliative treatment. Only 4 of the cases occurred in females.

TALIA, F. Plastic linitis. *Radiol. med.*, June, 1928, XV, 570–578.

A case of plastic linitis is described in a woman of forty. It was located in the pyloroduodenal region and its chronic course indicated that it was inflammatory in nature. The author adds the roentgen description of another case, this one a case of syphilis, and says that it is important to consider plastic linitis not as a pathological entity in itself but merely as a descriptive term. It may be inflammatory, neoplastic or syphilitic in nature.

TAYLOR, RAYMOND G. Surgical lesions of the right lower quadrant demonstrated in patients with chronic deforming arthritis by *x*-ray opaque meal examinations. *J. Bone & Joint Surg.*, January, 1928, X, 62–74.

The history in a good many of the cases with chronic deforming arthritis is usually sufficient to convince one that the gastrointestinal tract is at least a factor in the disease. The pathology of the intestinal tract in such cases is, however, of such a character as to be demonstrable by the opaque meal study. The best evidence of the intestinal lesions is obtained in the ascending colon and ileum and the cecum. These signs, together with the evidence as to motility in and mobility of the involved portion of the colon is obtained at the nine-hour observation of the opaque meal, which is the one most often omitted or ignored in the routine examination. It is easier to demonstrate at this observation the presence or absence of a filled appendicial lumen and to determine its mobility and the question of its tenderness than at any other time. It is believed that more appendices are visualized at this observation than at any other one observation in the series. The typical, most commonly found lesion is an adventitious membrane, originating on the posterior abdominal wall or mesentery that spreads out fan-shaped to the right over the ascending colon and is attached to its right peritoneal border. These membranes vary in actual length and in length of attachment to the colon, and have a definite tendency to limit the normal downward movement of the movable ascending colon and cecum. What happens when a patient with a lesion of this kind stands erect and gravity takes a loaded cecum downward into the pelvis is difficult to describe but easy to visualize if once the mechanism is understood. The only satisfactory way to demonstrate any of these lesions is with the roentgenoscope. Roentgenographic examinations alone will frequently result in failure to show the characteristic deformities and in failure to determine mobility as well as motility. For this reason, it is frequently difficult to show evidence of these lesions on films, while they may be easily demonstrated with the palpating hand before the roentgenoscope. The twist in the ascending colon is the most important factor in producing the local stasis that is found in the patients under consideration, and can practically always be recognized during the course of the opaque meal study if it is present. It is frequently necessary to place the patient in a standing position and observe him with the cecum dropped into the pelvis when there is seen a rather characteristic crook or kink, usually just above the ileocecal level and at the lower border of the membranous attachment, with a definite thinning of the shadow of barium at and distal to this point, due to a narrowing of the lumen of the bowel by the torsion.

VALLEBONA, A. Comparative roentgen and anatomico-pathological study of cavities in the lung. *Radiol. med.*, June, 1928, XV, 599–637.

The author reviews the roentgenology and pathological anatomy of lung cavities, describing the technique which he followed in making this comparative study. He made a roentgenographic and roentgenoscopic examination of the living subject, a roentgenographic examination of the lungs after they were removed from the thorax and an autopsy and photography of the sections. He gives histories of a number of the cases which seemed to him most interesting, illustrated by roentgenograms and photographs of the autopsy specimens. He then discusses the causes which may prevent roentgen demonstration of a cavity and conditions which may simulate cavity. He then discusses the value of roentgenoscopy, simple roentgenography, the injection of iodized oil into the bronchi and diagnostic pneumothorax. He discusses the different types of cavity, the way in which the cavity is formed, its evolution, the arrest of the process of evolution and eventual recovery. He briefly discusses differential diagnosis, showing the importance of such a comparative study both from the practical and scientific points of view.

VIVIANI, R. Clinical and roentgen diagnosis of postoperative duodenal ulcer. *Radiol. med.*, May, 1928, XV, 429–453.

A case of postoperative jejunal ulcer in a man of thirty is described, and the diagnosis discussed in connection with it. Among the

symptoms presented by the patient were attacks of pain radiating along the left side of the abdomen to the testicle which suggested a renal colic. The author thinks this was due to inflammation or compression of the nerves by the large inflammatory tumor around the ulcer. He thinks that even in the absence of definite objective signs such a pain may be considered an evidence of an inflammatory reaction around an ulcer. The roentgen examination showed an immense niche opposite the neostomy. The ulcer was diagnosed by the sum total of the roentgen signs rather than by the niche alone, but the author agrees with Busi that the niche is the only pathognomonic sign of ulcer. Ström says that a niche can be demonstrated in comparatively few cases but that even if it cannot the shadow of the jejenum shows characteristic changes. The outlines of the loop appear smooth without the normal dentation of the valvulae conniventes and there is a contraction of the musculature around the ulcer due to spasm or even to organic changes. Forssell objects that not enough is known of the normal roentgen appearance of the gastroenterostomy opening and the loop of jejunal to be able to diagnose an ulcer from these signs, and while the author agrees that they are not pathognomonic still he thinks they are of importance. He emphasizes the necessity for a careful roentgen examination even in the cases of jejunal ulcer that appear to be most definite clinically and of close collaboration between the clinician and the roentgenologist.

V. Falkenhausen, Frhr. M. A case of hernia hiatus esophagei. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 985–989.

The case reported occurred in a baker, aged thirty-two, suffering from bronchitis. An incidental a roentgen examination showed a striking shadow over the right diaphragm suggesting hernia. There was seen resting upon the right arch of the diaphragm immediately adjacent to the heart shadow a smooth-shaped, sharply outlined shadow about half the size of a saucer. In its upper portion there was a rarefaction of the size of a two-mark piece (a quarter?). The outline of the diaphragm below this abnormal shadow was clearly recognizable and appeared normal. During respiration both arches of the diaphragm moved normally. The shadow followed the diaphragm in all these movements without showing any changes in size. In the first oblique diameter the position of this structure was definitely fixed as close to the anterior wall of the thorax. Except for immaterial hilic calcifications, the lungs showed nothing unusual. The characteristic passage of contrast material after leaving the pylorus, the position of the stomach taken in conjunction with the entirely normal shape and function of the right diaphragm, all point unmistakably to a diagnosis of right diaphragmatic hernia. In this particular case, it was undoubtedly hernia through the esophageal hiatus. A large epiphrenal esophageal diverticulum may be excluded at once on the basis of the findings. In this case the condition was apparently congenital, because subjective symptoms were almost entirely absent, in spite of the great increase in the contents of the thorax.

Voorhoeve, N. The stomach as a vicarious air bladder following extirpation of the larynx. Associated aerophagy. *Acta radiol.*, 1926, vii, 587–594.

A description is given of the roentgen examination of a case of esophageal speech after extirpation of the larynx. This examination showed that the stomach can perform the function of the lungs as an air chamber. The stomach is not filled with air by active swallowing but by aspiration of air caused by inspiratory movement and the air is expelled from the stomach by an expiratory movement. In this process the cardiac sphincter of the stomach is actively opened. The mechanism of spasmodic aerophagy "par aspiration" as described by Linnosier necessitates the assumption that the oral part of the esophagus and probably also the cardia are actively opened by the patient.

Wallgren, Arvid. Epituberculous infiltration of glandular origin. *Acta radiol.*, 1926, vii, 595–603.

The term "epituberculosis" probably comprises several different processes which arise in different ways. Among other things, a tuberculous swelling of the bronchial glands can give rise to the clinical and roentgenological picture of epituberculosis. Two cases are cited as examples of this. The presumption is that the glandular swelling is so great that it compresses adjacent bronchi and vessels. From this there arise various different conditions which may bring about induration. The author lays particular stress on atelectasis, localized edema and hyperemia in the corresponding part of the lungs.

Werenskiold, Baasken. A contribution to the röntgen diagnosis of epiphyseal separations. *Acta radiol.*, 1927, viii, 419–426.

Genuine separations of the epiphysis without

displacement can be diagnosed by the detachment of a thin lamella from the diaphysis. This lamella lies in the space between the epiphysis and the diaphysis and has been observed as an incidental sign in 53 per cent of all cases of "mixed" epiphyseal separations. The genuine separations of the epiphysis are by no means rare; in fact, of all cases of epiphysiolysis of the radius, 20 per cent are of this type. Such occurrences are by no means restricted to young children; on the contrary, they are met with chiefly in patients ten to twenty years old.

Wessler, H., and Fried, Jacob. Encapsulated pericardial effusion. *Am. J. M. Sc.*, March, 1928, clxxv, 331–336.

Encapsulated pericardial effusion is a rare condition because it rarely happens that fluid in the pericardial sac is walled off by adhesions.

There are presented 4 cases of rheumatic heart disease in which there was clinical evidence of a fibrinous pericarditis and in addition signs of a unilateral enlargement of the heart. In each case there was a unique configuration of the heart which is interpreted as a localized pericardial effusion. The right border of the heart is extended to the midclavicular line and the left border remains in normal position. Such marked isolated enlargement to the right is never seen in any form of valvular disease of the heart. In one of the cases a roentgenogram made before the onset of the pericarditis showed the normal heart outline. In addition, there were no symptoms or physical signs of embarrassment of the circulation such as would be associated with a dilatation of the right side of the heart. Under any other assumption than that of a localized pericardial effusion, it is not possible to explain consistently with the known facts of the mechanics of cardiac enlargement a rapid enlargement of the heart shadow to the right as it occurred in these cases. Finally, the rapid recession of the right border of the heart coincidentally with an improvement in the condition of the patient is, from clinical experience, more plausibly explained by a resorption of pericardial exudate than by a decrease in the size of the heart. In 2 of the cases the deformation affected the left border of the heart.

Wideröe, Sofus. Urethrography and prostatography. *Acta radiol.*, 1927, viii, 563–570.

The author has employed 20 to 30 per cent solutions of sodium bromide, lipiodol or iodipin as contrast material. Sodium bromide gives good pictures but the contours are feeble. Iodipin has been employed in preference to the lipiodol because of cheapness. The iodipin is used for anterior urethrography and sodium bromide for posterior urethrography.

The investigation should be conducted with the bladder empty. The right leg is bent strongly and the left stretched straight out. The lateral position is so chosen that a transverse diameter of the patient's body makes an angle of 60° with the table and the film. The axis of the penis should be parallel with the body. The tube stand should be on the opposite side of the table to the surgeon. In the posteroanterior position the tube is carefully centered over the bulb of the urethra by means of a centering device. If the table is level the central ray should be directed vertically downward; if the table is tilted the tube also should be tilted to the same angle. The distance from the anticathode to the film should be 20 inches. In the oblique position the surface marking for the point of entry for the central ray is 1 inch below the middle of Poupart's ligament; the anticathode in this case being 24 inches above the film. The size of the film is of no importance provided it is large enough to include the base of the bladder as well as the urethra. Two exposures are sufficient: one in the anteroposterior and one in the oblique position.

The contrast medium is introduced by means of a syringe with a urethral point. Exposure should be made during injection. By this method a good picture of the anterior urethra is obtained. For this 25 c.c. of injection fluid is required. To demonstrate the posterior urethra the injection fluid is syringed into the bladder, the urethral orifice is compressed and the patient is ordered to urinate. If information is desired regarding the condition of the prostate, the patient is photographed lying on his back. During exposure the urethra is placed under tension. Illustrative pictures are given of the normal prostate and urethra as well as cases of stricture, false passages and enlarged prostate before and after operation.

Westermark, Nils. A case of Friedländer's pneumonia simulating tuberculosis with prolonged duration. *Acta radiol.*, 1926, vii, 626–631.

The case occurred in a man aged fifty-two, and had an extraordinarily protracted course extending apparently over six months. The longest duration hitherto reported in the literature was about eight weeks. The roentgen picture taken shortly before death disclosed the signs which are commonly interpreted as typical of tuberculosis. There was a pleural pneumonia in the upper portion of the right lung with cavity formation and also a beginning contraction of the thorax, the latter

being an indication of the relatively long duration of the process. The patient's history showed that he had been suffering for at least half a year from some condition before the acute stage. The case came to autopsy and the microscopic examination disclosed no signs of tuberculosis of the lung. The bacteriological examination revealed bacteria of the Friedländer pneumobacillus type.

## ROENTGEN AND RADIUM THERAPY

ABELL, IRVIN. Radium in the treatment of uterine pathology. *Surg., Gynec. & Obst.*, February, 1928, xlvi, 287–291.

The indications for the use of radium in the treatment of pathologic lesions of the uterus have become since 1920 more definitely defined; its dangers and contraindications have become equally clear. While it has not proved as widely efficacious as at first thought to be, its results in certain conditions have been demonstrated to surpass those of any other treatment heretofore employed. A brief review of the author's limited personal experience with it in the treatment of carcinomas of the cervix, carcinoma of the body, fibromyomas and uterine hemorrhage of functional origin is presented as a basis for discussion of some of the problems associated with such lesions.

In the treatment of carcinoma of the cervix, the average dose has been 3000 mg-hr. Of 31 patients, 22 have been traced and 9 of these are known to be dead, 9 are living and state that they are apparently well and 4 are known to have cancer. The use of radium alone in the treatment of the body of the uterus is believed to be contraindicated. This, however, does not apply to treatment where palliation is the only resource. The dose in such cases is from 2,400 to 3,200 mg-hr. The indications for the treatment of fibromyomas involving the body of the uterus are variously interpreted by surgeons and radiologists. The logical analysis of the situation according to the author is as follows: In women under forty presenting such growths, the treatment of choice is surgical removal, employing transfusion and irradiation in moderate dosage for the purpose of making operable those patients in whom continued bleeding and profound secondary anemia temporarily prohibit operation. The younger the patient, the greater the importance of the preservation of the ovaries. In women approaching the menopause, irradiation finds a comparatively wide field of usefulness, its limitations being determined by the size of the tumors and their situation, by pedunculation, by tumor degeneration and by adnexal disease. The dose of radium varies with the size of the tumor from 1,200 to 3,000 mg-hr.

In the treatment of uterine bleeding of functional origin, radium stands practically as a specific, finding in this field its most brilliant and consistent successes. The dose varies from 150 to 2,400 mg-hr., depending on the desired result to be achieved, whether it be diminution of uterine bleeding or the production of complete menopause.

BERETVAS, L. Sarcoma in the roentgen-ray scar after roentgen treatment of lupus *Radiol. med.*, June, 1928, xv, 638–649.

The patient was a man of forty-one who had had lupus vulgaris of the face since he was eight years of age. He had been treated by many and intense applications of roentgen rays which had caused serious roentgen dermatitis. Seventeen years later a fusiform celled sarcoma developed in the scar following this roentgen dermatitis.

BERVEN, ELIS. Operative and radiological treatment of malignant tumors of the mouth. *Acta radiol.*, 1927, viii, 473–537.

A statistical analysis is given of 323 cases treated at Radiumhemmet during the past two decades, the cases including cancer of the tongue, sublingual region, mandible, cheek and tonsils, as well as sarcoma of the tongue and tonsils. Tumors of the alveolar processes of the upper jaw and hard palate have not been included. The treatment was not exclusively with radium and roentgen rays, but since 1921 electro-endothermy, among other things, was used extensively. The principles for the treatment have, in the main, been the same as those outlined by Forssell.

The material for each localization is divided into four different groups. Group A comprises cases operable on admission and only radiologically treated; Group B included cases receiving combined surgical and radiological treatment, the patient either being given preoperative radiological treatment and subsequent operation or immediate postoperative radiological treatment to prevent recurrences; Group C comprises cases having undergone operation but who have only obtained radiological treatment after development of recurrences; Group D includes inoperable cases treated only by radiotherapy. Each of these four groups is divided into subdivisions according to the presence or absence of glandular metastases, Subdivision I including cases showing no demonstrable metastases at operation or admission, and II, cases with definite

clinical evidence of glandular metastasis. This elaborate subdivision has been made because of the great variation in prognosis as well as treatment.

The results of the treatment are summarized in numerous tables.

Detailed account is given of the origin and development of the glandular metastases as well as their bearing on the prognosis. From the point of view of technique of the treatment, the author divides his cases into three different stages. For Stage I comprising cases without clinically demonstrable metastases radiological treatment only is advised. It is shown that the results of radical surgical dissection of the glandular regions in these early cases are no better than those obtained by radiological treatment alone. For Stage II comprising cases with already developed but definitely operable metastases preoperative treatment is recommended with radium at a distance, followed by block dissection of the glandular regions on both sides of the neck if necessary, with subsequent postoperative radiological treatment. For Stage III cases on the borderline between operability and inoperability, the author advises against attempting surgical interference and recommends radiological treatment only. The risk of incomplete operations of malignant tumors is illustrated by cases from the literature and from the present series. Test excisions should be made only by the method of electro-endothermy and in immediate connection with the radiological treatment.

BOWING, HARRY H. The treatment of carcinoma of the rectum by irradiation. *Radiology*, September, 1927, ix, 179–191.

Those malignant diseases of the rectum in suitable situation anatomically respond favorably to irradiation. Most of the tumors are of the adenocarcinomatous type, the remainder being colloid carcinoma, squamous-cell carcinoma, sarcoma, benign tumor (polyp) undergoing malignant degeneration, etc. The grade of malignancy may influence the response to treatment; the individual variation in the patient to repair is also a factor. The type or grade of malignancy is important in deciding the treatment to be given and microscopic study of specimens removed is the most reliable index, as well as complete proctoscopic examination. The amount of radium to be used and filtration, time of application, is governed by the size and location of the mass. In case of massive, inoperable cases, the broken-dose technique is best, the treatment being individualized as far as possible, with a few days between applications and the treatment finished within two or three weeks. Suitable instruments for holding the radium applicator in position, packing instrument and vaseline gauze are necessary. The rectal lumen is packed with vaseline gauze before the radium is applied.

Four case reports are given of operable lesions. The lesions were small and apparently localized. Every effort was made to deliver a therapeutic dose and to avoid the possibility of irradiation proctitis. The first case was that of woman with a rounded rectal tumor 6 by 8 cm., about 3 cm. above the anus and extending up just above the first valve. The first treatment consisted of two universal silver tubes containing 50 mg. of radium sulphate (element) placed tandem in a tubular Para rubber wall applicator, walls 1 cm. thick and 8 cm. long. The radium was filtered through the silver wall of the tube, 0.5 cm., 1 mm. of brass and the rubber wall. These were maintained in position for twelve hours. Three days later a second treatment was given consisting of ten steel alloy needles containing 10 mg. of radium sulphate (element) introduced into the tumor. Each needle was placed in a field about 2.0 cm. in diameter, and these left for thirteen hours. The pathologic specimen was diagnosed as carcinoma. Within ten days it was found that the original tumor had entirely disappeared, and in its place there was an ulcer 1 by 2 cm. During the following year similar treatments were given, but the condition became steadily worse and the patient died, after infiltration of the anal tissues, rectovaginal fistula, enlarged inguinal nodes, multiple metastatic development in the abdominal wall and secondary infection as a complicating factor.

The second patient had been suffering from what was diagnosed as adenocarcinoma of the rectum. After radium the mass was reduced 60 to 70 per cent. Later examination showed an ulcer 3 by 1.5 cm. occupying the former site of the tumor. Four months after the first treatment examination showed perirectal infiltration and proctoscopic examination showed the rectum to be surrounded by a fixed mass. A left modified Mixter type of colostomy was performed. A pathologic specimen showed ulceration and extensive fibrosis, but no evidence of carcinoma. Convalescence was uneventful and the patient remained in good health.

The third patient, a man aged fifty-six, suffering from a carcinoma of the rectum, refused operation. A combination of radium and roentgen-ray treatment was instituted. The radium was applied as described above and a month later roentgen-ray treatments as follows were given: 200 kv., 50 cm. distance, 5 ma., filtration through 0.75 mm. Cu and

2 mm. Al, time one hour and thirty minutes, on one posterior area 20 by 20 cm. Two months later there were no rectal symptoms. Local cleansing enemas afforded relief from the mucous discharge. A grayish ulcer 1 by 2 cm. replaced the original lesion. The patient apparently was entirely relieved from the rectal symptoms and continued in good health.

The fourth case was that of a man, aged seventy-five, suffering from a large operable carcinoma of the rectum. After radium treatment, surgical diathermy was employed, and later roentgen treatment as given in the case above. The results were satisfactory and the functions of the rectum became normal.

These cases are typical of the operable carcinomas in which, when treatment is instituted early enough, favorable results are to be expected. After treatments have been discontinued, proctoscopic observations should be persisted in for several years, at first every few months, and then once a year.

Coliez, R. Technique of telecurietherapy. *J. de radiol. et d'électrol.*, Nov., 1927, xi, 581–599.

The original method of applying radium was by placing the tubes inside the tumor to be irradiated. It was soon found that the distribution of the radiant energy around these foci was very irregular. Plates are given showing the curves of isodoses around such a focus. The general effect was to sterilize the center of the neoplasm, but it continued its growth at the periphery. The second plan was the use of plastic apparatus, inaugurated in 1921 which made it possible to place the radium at a short distance from the skin. But in the attempt to get sufficient effect at a sufficient distance, the apparatus became so cumbersome and so heavy that this led naturally to the method of telecurietherapy, or radium treatment at a distance. This is a special variety of radium treatment characterized by the use of large doses of radium (0.3 to 5 gm.) kept by means of special supports at a distance of about 10 cm. from the skin. Illustrations of the apparatus and diagrams and mathematical formulae showing the distribution of the irradiation by this method are given. Opinions are quoted from the leading radiologists showing the value of the method.

D'Amato, G. Treatment of bone and joint tuberculosis by secondary irradiation (Ghilarducci's method). *Radiol. med.*, May, 1928, xv, 452–468.

The author reports the first results of his experiments in roentgen therapy by means of secondary rays produced in the tissues themselves by iontophoresis (Ghilarducci's method), combined with the technique of Jüngling, and climate and sunshine treatment. From his experience the author is convinced that this method gives results incomparably superior to those that can be obtained by simple roentgen therapy. His results were brilliant in fistulous forms and in forms in which roentgen therapy by primary irradiation and heliotherapy have heretofore been considered ineffective.

Dautwitz, Fritz. Lymphogranulomatosis and radium treatment. *Strahlentherapie*, 1927, xxv, 375–401.

Although the radium treatment of lymphogranulomatosis is not as old as the roentgen treatment and although the number of radium treated cases is very much smaller than the roentgen treated, nevertheless the results of the radium treatment have demonstrated their practical value by extending the average duration of life of such cases to at least three years ten and a half months, and also by an ability to control roentgen-refractory cases, by prolonging life in a tolerable manner and even favorably affecting the psyche of these wretched sufferers. The author has had under observation 56 cases, 17 of which were treated primarily with radium, the remainder being roentgen-refractory recurrences or post-operative cases. Six of the total are alive and well, 2 being in the third, 2 in the fifth year, one in the fourth and one in the eighth year after beginning of the radium treatment. Four of this group were those treated primarily by radium, one is a recurrence after operation and the last a recurrence after roentgen treatment. Six of the cases were lost sight of. The average duration of life of the whole group is three years; the average duration of life of the 39 cases of recurrence and roentgen insensitiveness was three years ten and a half months.

The encouraging effect of the radium treatment is evidenced by considerable improvement in the general condition, a rapid increase in the body weight and general improvement of the mental condition. Except for one patient who appeared for radium treatment five days before death, the author has not encountered a single failure to improve the condition by gamma radiation. No noteworthy systemic disturbances occurred after treatment. Six cases are reported in considerable detail to illustrate the effectiveness of radium treatment in lymphogranulomatosis.

Radium was applied externally with preparations containing 16 to 99 mg. radium

element, sometimes distributed over surfaces up to 28 × 26 sq. cm. and sometimes contained in glass tubes 2 to 5 cm. long. Several such devices filtered through 1.5 mm. lead were placed 2 to 4 cm. from the skin over the tumor and allowed to act for six to twelve hours, during which time the patient was free to move about. The intervals between successive treatments were only exceptionally longer than fourteen to thirty-six hours. A single series lasted about one to four weeks, depending on the demands of the individual case. The quantity of radiation delivered during a series varied according to the extent and position of the diseased focus quite considerably (roughly from 6,000 to 30,000 mg-hr. radium element).

del Buono, P. Roentgen castration by irradiation of the hypophysis. *Radiol. med.*, May, 1928, xv, 486–495.

Clinical reports seem to show a close relationship between the function of the hypophysis and that of the ovary and uterus. Irradiation of the hypophysis has given good results in primary and secondary amenorrhea, dysmenorrhea and other syndromes due to ovarian dysfunction. It has also given good results in hemorrhagic metropathy and in hemorrhages caused by inflammations of the uterus, adnexa and ovaries. The author irradiated the hypophysis in dogs and rabbits using the doses which in women had caused functional changes in the uterus and ovaries but the irradiations did not cause any histological changes in the hypophysis. Possibly the histological changes seen by other authors, if they really existed, were due to the necrosis caused by enormous doses of the rays or at any rate much stronger than those which cause the functional changes in women mentioned above.

Finkenrath, Kurt. A case illustrating the effect of combined radiations on the skin. *Strahlentherapie*, 1927, xxv, 591–592.

A girl, aged twelve, with a colliquative tuberculosis of the skin and lupus was given radium treatment (21.8 mg.) for removal of interfering scar keloids after the Finsen treatment of the lupus. These radium treatments were applied locally and did not cause any unusual reactions. After the fifth radium treatment the patient also received general exposures from a carbon arc lamp (Aureol lamp) for the general treatment of the tuberculosis. At the time of the eighth radium treatment, it was decided to save time, and the exposures to the radium and to the carbon arc lamp were made simultaneously. The radium preparation was fixed in the axilla. After fourteen days the radium exposed area showed a pronounced erythema with central ulceration. Subsequent radium treatments alone did not produce this reaction. It seems fairly reasonable to assume that the combination of the two irradiations was responsible for the accelerated effect.

Some experiments on the photographic effect of the radium radiations with and without simultaneous carbon arc and quartz lamp exposures showed a similar intensification of the photochemical action of the radium.

Goldstein, L. The roentgen treatment of laryngeal tuberculosis. *Strahlentherapie*, 1927, xxv, 402–419.

Roentgen rays apparently produce a stimulation of secondary nature upon tuberculous foci. The radiations stimulate scar formation in the productive type of the disease and accelerate the breakdown process in the exudative type. The processes appear to be accounted for by some fermentative effects on the epithelioid cells. The enzymes are set free apparently in the breakdown of the lymphocytes and similar cells by the radiations.

The author's experience covers 24 cases, 11 of which form the basis for the present study. The results of the treatment suggest its applicability even in ambulant cases. Three of the 11 cases showed an exacerbation following roentgenization. One case showed no improvement. Slight improvement was obtained in 2 cases. Distinct improvement occurred in 3 of the cases. In 2 cases there was practically complete cure of the tuberculous process. In all the cases there was definite subjective improvement after irradiation. Hoarseness was often cleared up and pain disappeared. In summary, 7 cases, over 63 per cent, were improved by the roentgen radiation as to the local condition, although the general condition and tuberculosis of other organs were left practically unattended.

Judging from the experience of other workers, the method of roentgen treatment seems to be especially applicable to the productive type of laryngeal tuberculosis. The indication for roentgenization seems to be especially clear in this type of infection. All other types should be judged individually and subjected to roentgen treatment with great caution. The optimal dose of radiation lies between $\frac{1}{2}$ and $\frac{1}{3}$ of the skin erythema dose. The technique of choice is deep irradiation. The author's technique was as follows: Two lateral fields received 30 per cent of the skin erythema dose through 0.5 mm. Zn plus 3 mm. Al, 25 to 30 cm. focal skin distance, 4 and 8 ma., 180 kv.